he Welding Engineer

NEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

olume XXV September, 1940 Number 9

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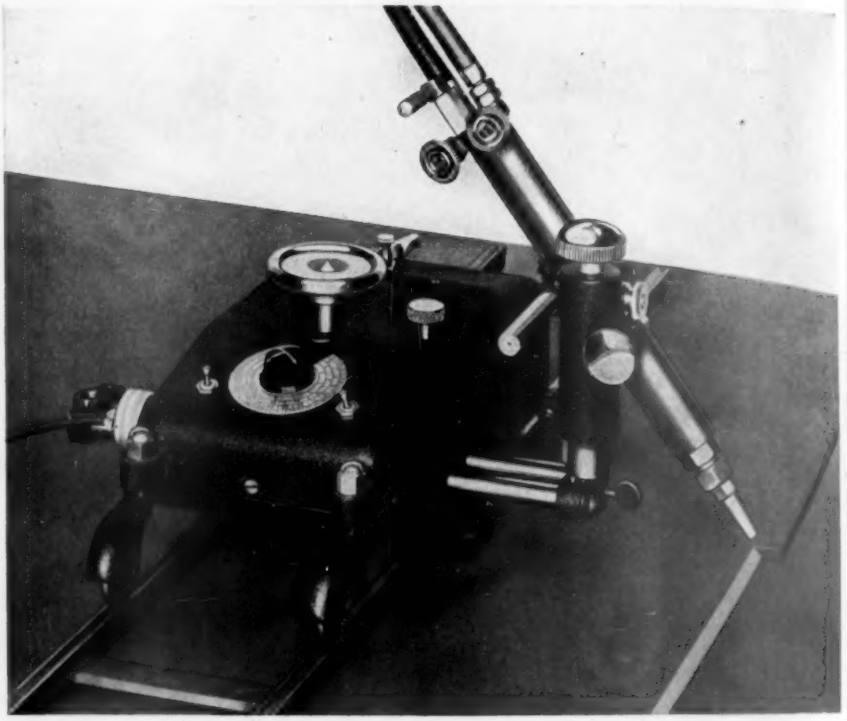

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SEPTEMBER, 1940

The Welding Engineer

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Two Birds with one Stone?

It's Quite Simple . . .

Tie up your products with the National Metal Show and the national defense program in The Welding Engineer Metal Show Issue. Those designers . . . metallurgists . . . superintendents . . . foremen . . . and buyers directly charged with rearming the country quickly and efficiently, need full knowledge of welding, its products and what the process can do for them in their work. They will attend the Metal Show by thousands.

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goes to every important fabricator

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THE WELDING ENGINEER METAL SHOW ISSUE

(October, 1940)

The complete program of the American Welding Society Annual Meeting will appear, a list of the exhibitors, their products and booth numbers will be included in addition to the regular editorial section of authoritative, thought-provoking articles. The October issue will be in the mails in ample time for these men to plan their week and list the things they want to see and study in detail. Assure their attendance at your booth by advertising in complete detail the products you will exhibit.

Cash in on the increased buying power that is available to you in Welding Engineer advertising pages. The June publishers statement (six months ending June) reflects the first results of the circulation building program that has been in effect for the past year — 601 increase in Total Net Paid — 581 (app. 97%) in the Managerial and Engineering groups. Total distribution 7500 copies per month.

As a *plus* value, 10,000 copies of the October Metal Show Issue will be printed with the extra copies *directed* to those interested industrial fabricating plants not regularly served by The Welding Engineer. You will reach *both* those men who will attend and *in addition* those who must remain in busy plants to keep the wheels of industry humming.

The October Issue offers you the biggest buy ever offered by The Welding Engineer. Make your reservation now. Forms close September 25 if proof of copy is to be submitted.

THE WELDING ENGINEER

506 South Wabash Avenue Chicago, Illinois

Business Needs A Business Man

WE ARE soon to select our next president. A selection that calls for impartial yet sound thinking — thinking backed by engineering logic. By the logic of our two-party system, the choice for president lies between Wendell L. Willkie and Franklin D. Roosevelt.

Mr. Roosevelt, after eight years of bungling, fumbling and broken pledges, seeks to violate a precedent so firmly embedded in American democratic traditions that it has become an unwritten law respected by most of us as much as the Constitution itself. He portrays himself as "The Indispensable Man", just as each of the modern dictators of the world pictures himself as indispensable to his country. In doing so his ambitions cause him to seek a goal that Washington, Jefferson, Jackson and other presidents felt was unwise in a democracy.

In his eight years in office, Mr. Roosevelt has ruthlessly punished business and has said that he did so to help the men whose welfare depended on business. He killed pigs to improve the hog market. He paid farmers for not raising crops. Contrary to all theories of economics, he scattered money in astronomical quantities in a vain effort to borrow and spend his way back to prosperity. Consequently in a period when the United States was at peace he doubled our national debt, reduced our national income, and lowered the per capita income to nineteenth century levels.

Quoting from an editorial in the August 20, 1940, Cleveland Plain Dealer, a Democratic newspaper recommending the election of Wendell L. Willkie, after supporting Democratic presidential candidates for 99 years:

"He campaigned on the class issue by denunciation of 'economic royalists'. He filled the ranks of his administration with radicals, leftist thinkers and social experimenters. He obtained the support of John L. Lewis by abdicating much of this authority to labor. He kept Secretary Perkins in the cabinet and remained deaf to complaints that she, Chairman Madden and many other of his appointees, were furnishing protection for radical elements on the labor front.

"He tried to persuade a Congress, which proved wiser than himself, to pack the United States Supreme Court and bring it under the thumb of the executive. Stooping from his high position as president of all the people he prosecuted a countrywide "purge" of Democrats who had refused to do his bidding."

And last but not least, after a year of political maneuvering in which he would not declare his intentions, nor allow any other candidate's name to be seriously considered, he was "drafted" as a third-term candidate. And then, having had himself placed at the head of the ticket, he demanded (yes, even dictated) that a rebellious convention name for vice-president, a cabinet member whom few in the convention wanted.

If given a third term, there will be nothing to prevent him from seeking a fourth, fifth, and so on. As stated in an editorial in the Chicago Tribune, August 26, 1940: "Mr. Roosevelt's conscience was no friend of his nation. If he wishes he had more than one life to give to his country, it would be to spend all of them in the White House."

As the president's opposition we have Wendell L. Willkie, an unknown figure in national politics, who became the candidate of an unbossed convention. As the people's choice, Willkie's nomination came as the result of a specific demand for a man trained to meet those problems which will face the national administration during the next four years.

Mr. Willkie's career is typically American. Born in a small town, educated at a state university, he became a small town professional man after a varied career that took him around the country as a worker in the wheat fields, mining camps, oil fields and industrial plants. Trained by hard knocks, he understands and has the confidence of industrial leaders. Likewise he possesses a record of fair dealing with labor.

From a small beginning, Mr. Willkie has traveled the same road which thousands of other Americans have traveled in climbing to a position of successful leadership.

So when we go to the polls in November, let us all go with this thought in mind: Let's take the saddle off of business and put a businessman in the saddle.

No. 2 OF A SERIES SHOWING HOW STOODY SAVES YOU MONEY!

WHETHER YOU DREDGE CANALS OR MAKE STEEL

Stoody

SAVES YOU MONEY!

The equipment used in making steel is hardly comparable to the equipment used in dredging, yet the maintenance problems of the two industries are much the same. The charging rams, manipulator bars, pinch rolls, spindles and dozens of other parts used in making steel wear out rapidly—and so do the cutters, impellers, head liners, pump casings and other pieces of equipment used in dredging—the big job in either type of business is to keep replacement and maintenance costs to a minimum.

Hard-facing has become the accepted method of reducing costs in both industries, but it is obvious that the metal used to increase the cutting efficiency of a dredge pump cutter might not be suitable for hard-facing the wearing surface of a mill guide—and that the metal used on a shear blade might not be satisfactory for surfacing an impeller.

In order to get maximum service from any type of equipment the hard metal used must have the proper characteristics. That's why you will find such a variety of Stoody hard-facing metals used in the steel mills as well as on dredging boats. For example, in the dredging industry, Tube Borium is used on the cutters, Stoodite on the shoulders of pump casings, Self-hardening on the impellers. In the steel mills, Silfram is usually applied to shear blades, Stoodite "63" to arbors, Stoodite to the guides, pinch rolls and charging rams, Self-hardening to the manipulator bars, guide bars, spindles and roll ends.

If some part of your equipment wears out rapidly, investigate the Stoody line of hard-facing metals. Your Stoody distributor will be glad to help you select the proper alloy and suggest the correct welding procedure.

STOODY COMPANY
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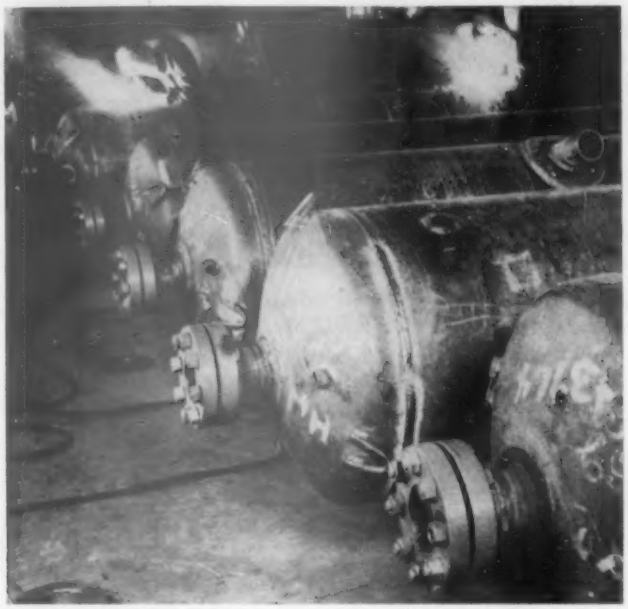

Welding of oil and gas separators on a production line basis.

Review of
welding procedures

For Creep — Resistant Steels

★ Explanation of high-temperature creep—why creep resistance is important factor in pressure vessel design — Preheat recommendations.

By HARVEY THOMPSON

TO OBTAIN MORE efficient operation in boilers and refinery vessels, increases in both temperatures and working pressures have been demanded. Were it not for the recent studies on creep resistance of steels many vessels for high operating temperatures, would require such thick shells as to make their manufacture economically unsound. The adaptability of carbon-molybdenum steels to high temperature service gives industry safe vessels of not too great a wall thickness. Notwithstanding the increased cost of the plate material, the reduction in fabrication cost results in substantial overall savings.

What is creep? Why is it so important in high temperature pressure vessels In fact, what is meant by high temperature? Creep is that behavior of a metal that leads to continuing deformation at loads well within the yield point of the material. Usually the creep of metals is measured by applying a constant load at a constant temperature and measuring the elongation of the specimen with respect to time. Elaborate creep testing installations maintain the temperature within 2 deg. F. Constant dead load is invariable. And the elongation is measured very accurately. To obtain proper creep information requires long time tests with 1000 hours and 10,000 hours generally accepted as standard test periods. Creep strengths are then reported as the stress that will produce an elongation of 0.01% in 1000 hours or 0.10% in 10,000 hours.

Since the thinner sections employed in the design of vessels using creep resistant carbon-molyb-denum steels place an added importance on the ravages of corrosion, all installations where corrosion is a factor warrant special attention. Sometimes the practice of allowing additional metal thick-

ness for corrosion will suffice. At other times where corrosion is rather severe, the need of corrosion proof linings is indicated. Generally the purchaser of the pressure vessel is familiar with the amount of corrosion to be encountered; and his designers specify the treatment of this phase of the problem.

Carbon-molybdenum steel plates for boilers and other pressure vessels correspond to ASTM designation: A204-39. Three different tensile strength ranges are available. These steels are known as grades A, B and C. The chemical requirements are listed in Table 1.

From a study of the chemistry of the carbon-molybdenum steels it may be seen that the steel is readily welded. For the molybdenum has almost no influence on hardenability, while the amount of silicon present has only a slight influence. The increased carbon content over that found in ordinary low carbon steel will exert the strongest influence of any of the elements present.

Next a consideration of the physical properties of the carbon-molybdenum grades appears to be in order. In Table 2 these factors are listed.

These strengths are exceeded by the strength of the weld metal as in the case of mild steel. A set of typical test results obtained from plate 1¼ in. thick is presented in Table 3.

Table 1—Chemical Requirements of ASTM A204-39

	Grade A*	Grade B*	Grade C**
Carbon, max., per cent:			
For plates 1 in. and under	0.18	0.20	0.23
For plates over 1 to 2 in.	0.21	0.23	0.26
For plates over 2 to 4 in.	0.23	0.25	0.28
For plates over 4 to 6 in.	0.25	0.27	.....
Manganese, per cent	0.50–0.90	0.50–0.90	0.50–0.90
Phosphorus, max., per cent, flange Firebox	0.04	0.04	0.04
	0.035	0.035	0.035
Sulfur, max., percent, flange Firebox	0.05	0.05	0.05
	0.04	0.04	0.04
Silicon, per cent	0.15–0.30	0.15–0.30	0.15–0.30
Molybdenum, per cent	0.40–0.60	0.40–0.60	0.40–0.60

* Covering plates up to 6 in., incl., in thickness.
** Covering plates up to 4 in., incl., in thickness.

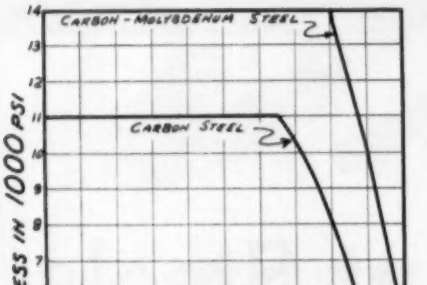

Fig. 1—Allowable working stresses for carbon and carbon-moly steels.

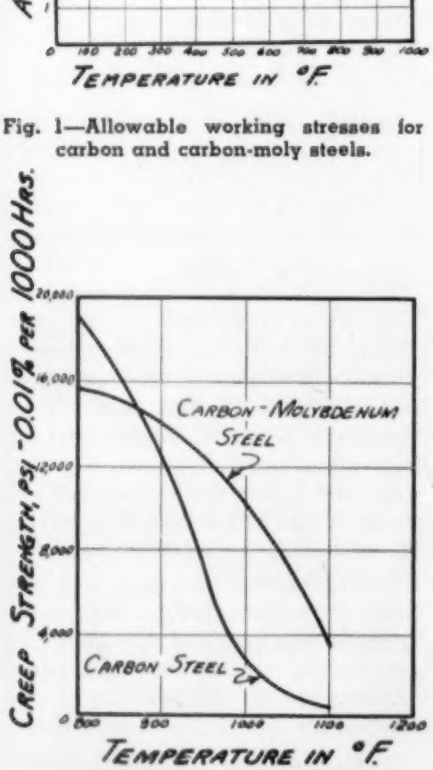

Fig. 2—Creep strength of carbon and carbon-moly steels.

Fig. 3—These "obround" nozzles were made by a combination of flame-cutting and arc welding.

Table 2—Tensile Requirements of ASTM A204-39

	Grade A	Grade B	Grade C
Tensile strength, psi.	65,000–77,000	70,000–82,000	75,000–87,000
Yield point, min., psi.	0.55 tens. str.	0.55 tens. str.	0.55 tens. str.
but not less than	37,000	40,000	43,000
Elongation in 8 in., min., per cent, flange	1,600,000	1,600,000	1,600,000
	tens. str.	tens. str.	tens. str.
Firebox	1,650,000	1,650,000	1,650,000
	tens. str.	tens. str.	tens. str.
Elongation in 2 in., min., per cent, firebox	1,750,000	1,750,000	1,750,000
	tens. str.	tens. str.	tens. str.

Table 3—Weld Tests on Grade B Carbon-Molybdenum Steel

	As Welded	Stress Relieved
Free bend, per cent	21.8	38.8
Reverse bend, per cent	21.2	43.3
Full section tensile, psi.	81,100	80,200
Reduced section tensile, psi.	86,500	82,600

Both welds reported in Table 3 proved sound upon radiographic examination so that this factor has not influenced the test results. Of much importance is the difference in bend elongation between the as-welded and stress-relieved values. Clearly indicated is the need for stress relieving.

To continue with the questions raised earlier, creep resistance is important in pressure vessel design, because cross-sectional area diminishes as the vessel elongates. In the early days before much was known about creep, many failures resulted from this cause. In connection with creep, high temperatures are generally considered to be from about 900 deg. F. to 1100 deg. F.

Fig. 4—This portable x-ray unit can be taken to the job, thereby reducing handling of heavy vessels.

Figures 1 and 2 illustrate the maximum allowable working stress and creep strength of mild steel and carbon-molybdenum steels respectively. Although the indicated allowable working stresses for the carbon-molybdenum steels are more than twice those for mild steel at elevated temperatures, some designers and manufacturers insist upon an allowable working stress no more than twice that of mild steel. This is a very conservative trend that does not appear to be warranted by the service and test data available at this time.

One important consideration in the manufacture of welded pressure vessels is the greater stiffness of carbon-molybdenum steel. As the yield point increases, the amount of work necessary to roll shells becomes greater. Thus some attention must be given to roll capacity when the change is made from low carbon to low-alloy material.

There are a few simple precautions that should be observed in the welding of this low-alloy material. Foremost among these precautions is preheating. Once more the amount of preheat should be considered as a function of the plate thickness. To be fair this statement does not agree with all the published comments on the subject. In general preheats of from 300 to 500 deg. F. have been recommended regardless of the plate thickness. But experience has shown a preheat of 200 deg. F. to suffice for plates under one-inch thick, while no more than 400 deg. F. appears to be demanded for pressure vessels of wall thickness greater than one inch. These preheats should be measured with Tempils so as to be sure of the right preheat temperature.

Just as the low-alloy steels afford more resistance to rolling so do they offer more resistance to chipping. Labor costs of chipping will show a decided rise when this material is being fabricated. But no difference will be noted where flame-deseaming is employed. However, at this point, it may be well to preheat for all gouging and oxygen-cutting operations. Also, the maintenance of interpass temperatures is important. Too often there is a tendency to preheat at the beginning of a welding operation, without remembering that the preheat temperature must be maintained for all welding and cutting.

Peening of carbon-molybdenum steel performs grain refining in the same manner as it does with mild steel. Enough peening to remove all of the weld ripple marks will suffice. Just as a prescribed amount of medicine will do good, while an overdose may do much harm, peening should be adequate but not overdone. Work hardening results in brittle structures without sufficient resistance to stress to prevent crack formation. This is a sure aftermath of too much peening.

There are a number of electrodes on the market to perform the welding of molybdenum-bearing steels. In general electrodes are divided into two classes: downhand and all position. Since the carbon-molybdenum steels are used in rather heavy section, no need exists for an electrode of the rutile coating "poor-fit-up" class. Usually the alloying element is contained in the coating with the core wire having the same mild steel analysis as that used in welding low carbon mild steels.

No difference in electrode manipulation exists, although the all-position electrodes appear to require less heat with an attendant slower deposition rate. This factor must be considered in labor analyses. The appearance of finished welds is quite good. Highly skilled operators say that the alloy weld metal is more easily controlled than that of ordinary steel. The difference, however, is slight.

Radiographic results are in line with those of the non-alloyed steels. If anything, there is a slight advantage in the higher strength material, attributable, no doubt, to increased concentration of the welding operator who knows he is welding an alloy material. Cut-outs are quite infrequent. Where necessary they may be made with the gouging torch of large tip size, or with a heavily-coated electrode at high amperage. Here, too, heat shock is to be avoided. Generally the heat of the gouging operation is sufficient to provide enough preheat if welding follows directly.

(Continued on Page 34)

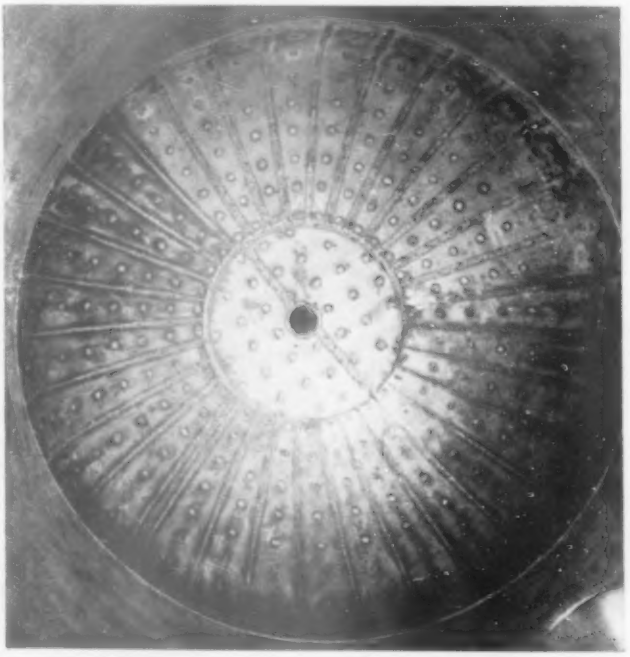

Fig. 5—A plug-welded Monel liner protects the head of this pressure vessel from corrosion.

Cleveland Meeting to Discuss Welding as National Defense Aid

★ With industry gearing itself to meet the increasing demands of the Preparedness Program, this year's meeting of the American Welding Society in Cleveland from October 20 to 25 assumes greater importance than any previously held in the 21-year history of the Society. Welding, cutting and allied processes are rapidly becoming recognized as one of the metal-working industry's most valuable tools for eliminating bottlenecks and speeding production schedules.

It is expected that hundreds of engineers, executives, and production men will gather at the Hotel Cleveland to hear experts in every phase of welding discuss new processes that are helping the shipbuilding, steel, aircraft, railroad, machinery manufacture and other industries meet the demands for national defense. During the five-day meeting, leading authorities from all parts of the country will present 59 technical papers covering practically every aspect of the welding, cutting and treating processes.

Shipbuilding and Steel Mills

The first session on Monday morning, October 21st, will be devoted to papers on welding in shipbuilding and the welding of rigid frame structures. Two simultaneous technical sessions will be held on Monday afternoon—one on steel mill applications of welding, and the other on industrial research.

Machinery Manufacture

On Tuesday the 22nd, simultaneous sessions will be held in the morning and afternoon on machinery manufacture and on fundamental research. Featuring the two machinery sessions will be papers on flame-hardening, flame-machining, machine flame-cutting, and mechanized oxy-acetylene welding. The part these processes play in turning out metal products in less time and at less cost will be covered in detail.

Resistance Welding

Resistance welding will be covered at two sessions to be held on Wednesday morning and afternoon. Among subjects to be discussed are resistance welding and spot welding electrodes, recorders and indicators for resistance welding machines, the spot welding of copper base alloys, resistance brazing in electrical apparatus manufacture, and spot welding in aircraft construction.

Industrial Research

Research subjects, including the causes of crater formation, characteristics of hard-facing deposits, and the improvement in weld ductility by aging, will be discussed at a combined fundamental-industrial research session on Wednesday morning. Problems in the design and construction of bridges and other welded steel structures will be covered at a structural steel session Wednesday afternoon. Among papers to be presented at this session is one on the flame-cleaning method for preparing structural steel surfaces for painting.

Operator Training

The first of two simultaneous sessions on Thursday morning will be devoted to pipe welding, while a second session will cover procedure controls and special applications of welding. Featuring this latter session will be a paper on training operators for welding, a subject of primary importance today because of the insufficient supply of capable operators in many sections of the country to handle the increased demands of industry. Other timely papers to be presented att his session include one on aircraft welding and another on codes for welded pressure vessels.

No technical sessions have been scheduled for Thursday afternoon so that members and guests of the American Welding Society may attend the industrial exhibits at the Public Auditorium.

One of two simultaneous technical sessions on Friday morning, the 25th, will be devoted to metallurgical aspects of welding. At a second session on the railroad industry, the use of welding in tank car and passenger car construction will be covered in detail.

Special Features

The special features for this year's meeting include the President's Reception on Sunday afternoon, October 20, the presentation of medals and awards on Monday morning, the Annual Banquet on Thursday evening, and the plant inspection trip on Friday afternoon.

Since a record attendance is expected, members and guests who are planning to attend this meeting are urged to make their reservations now, direct with the Hotel Cleveland. A copy of the complete program can be obtained by writing to American Welding Society, 33 West 39th St., New York, N. Y.

Construction

H. C. Price Co. of Bartlesville, Okla. has been awarded contracts for electric arc welding on the following pipelines:

For United Gas Pipe Line Co.—Mississippi River Crossing near St. Rose, La.—General contractor Ford, Bacon & Davis Construction Corp.

For Gulf Oil Co.—12 miles of 6-in. and 8-in. near Centralia, Ill.—General contractor Jones & Brooks, Inc. of Nevada.

For Shell Petroleum Co.—6 miles of 6-in. near Sandoval, Ill.—General contractor I. C. Little.

For Illinois Pipe Line Co.—57 miles of 8-in. and 10-in. from Centerville, Ill. to Bridgeport, Ill.—General contractor Sheehan Pipe Line Construction Co.

For Montana-Dakota Utilities Co.—120 miles of 8-in. and 20 miles of 3-in. from Glendive, Mont. to Glascow, Mont. —General contractor W. A. Bechtel Co.

For Tuscarora Pipe Line Co.—10 miles of 8-in. near Harrisburg, Pa.—General contractor Dempsey-Wilson Construction Co.

For Panhandle Eastern Pipe Line Co. —55 miles of 24-in. consisting of three loops in Illinois—General contractor I. C. Little.

For Atlantic Refining Co.—8 miles of 16-in. near Philadelphia, Pa.—General contractor Dempsey-Wilson Construction Co.

8,600 Welded Steel Piles—Welding was an important construction tool when the **Western Foundation Co.**, Chicago, Ill., drove 8,600 steel piles for the foundation of a large midwestern factory building. The piles were formed by welding together 30-ft. sections of 18-in. square pipe having a ½-in. wall, and were driven to a depth of more than 100 ft.

As each 30-ft. length approached ground level, another section was hoisted into place and welded to it with the aid of General Electric electrodes, Type W-20, and a G-E arc welder. When these pipes had been driven the required distance, 12-in. H-beams—108 ft. long—were driven into them and concrete was poured.

Types of water heater tanks which are commonly fabricated by means of automatic arc welding.

Review of fluxes used for

Automatic Arc Welding

By WILLI M. COHN

Consulting Engineer, El Cerrito-Berkeley, Calif.

The author presents a review of patents referring to fluxes for automatic electric arc welding of steel plates, etc. The development of various fluxes is discussed, resulting in improved products. The development seems to lead from fluxes composed of a mixture of various raw materials to fluxes containing glass as a major constituent; the latest development is that of fluxes based on synthetic crystalline materials of definite composition.

AUTOMATIC ELECTRIC arc welding of steel plate has opened up a comparatively new field and it has, for certain purposes, great advantages over hand welding. Automatic electric arc welding is being carried out by means of stationary welding machines, or by means of small movable units ("crawlers"). The plates to be joined, such as a pipe or pressure tank, are clamped together or welded at a few spots. The electrode is in the shape of a wire which is continuously fed from a reel into the welding zone. The electrode is moved along the seam or vee to be welded. The arc passes from the electrode to the work, depositing metal from the electrode and fusing the plates sufficiently to obtain, on cooling, a strong bond between the plates. A weld of excellent mechanical and chemical properties is obtained by the use of a flux which is introduced into the welding zone. The welding operation is entirely automatic, with exception of starting the machine and replacing, from time to time, the electrode and the flux.

Recent improvements in automatic electric arc welding have been in mechanical equipment, in electrical equipment, and in welding flux. Mechanical and electrical improvements have been discussed fully in several papers which have been published in the welding literature. (Data concerning fluxes for hand welding and coated electrodes are given in papers by Lueder (1) and Spraragen and Claussen (2), and in the book by Schimpke and Horn (3).)

Functions of Welding Flux

Desirable properties of a flux used in automatic electric arc welding are of a chemical and a physical nature, as follows:

(1) The oxidation and nitration of materials from the electrode and of the weld proper should be prevented.

(2) The electric arc should be stabilized and its ignition and re-ignition should be facilitated.

(3) Impurities from the electrode and the base metal should be removed.

(4) Sputtering of metallic particles should be prevented.

(5) A slag should be formed which will quickly rise to the surface of the molten pool in order to prevent non-metallic inclusions and pores in the weld; the slag should form a protective, solid coating over the freshly-deposited weld metal, which will protect it against oxidation and nitration; the slag should retain enough heat to prevent a fast cooling of the weld (annealing action); the slag should be easily removable or should automatically peel off the weld after cooling.

(6) It should be possible to add certain ingredients to the base metal such as may be desirable, for instance, manganese, titanium, and molybdenum.

(7) All reactions during or immediately following the welding should be completed at the highest possible rate of speed in order to assure a great rapidity of welding.

It should be realized that it is rather difficult to fulfill all these requirements for a flux, because of the high temperature of the electric arc and because of the short time of heating a given point along the seam. On the contrary, an electric arc furnace allows sufficient time for the completion of all reactions and for reaching an equilibrium of components. In former years, it was thought essential that the melting point of the flux be below, or at the temperature at which the electrode and the work melt. However, the author has demonstrated in his patent cited below, that this is not the case.

Supplying Flux

Two ways are known for supplying flux to the arc:

(a) Coated electrode. Originally, the same type of electrode was used in automatic welding as in hand welding. A stiff-wire electrode with a coating of flux was placed into the welding head of the machine. Later, attempts were made to increase the length of the electrode without bending it, but practical limits were soon reached. Then, continuous coils of electrode wire were tried, which proved successful in many cases. Several makes of coated electrodes have been on the market, including both lightly coated and heavily coated electrodes which are used according to the manufacturing problem. However, the use of this type of electrode in sizes large enough to carry high currents, for instance 600 amp., becomes increasingly difficult: One, to make the flux stick to the heavy wire, and, two, to secure electrical contact to the electrode (the sheath being non-metallic and non-conducting when cold).

(b) Bare-wire electrode and separate flux. Another method of supplying flux to the arc is to fill the notch between the plates to be welded with the flux. This may be done by hand before starting the weld, or from a bin moving along with the welding head and depositing flux in front of the electrode. The electrode is projected down through the layer of flux and the arc is established to the work; see Figure 1. (However, Jones and collaborators claim in their patent (see below) that by the use of their flux no arc is required for welding, but the necessary heat is generated by the passage of an electric current through a highly resistant flux.) The electrode passing through the flux is advanced along the seam to be welded, while the bare welding wire is fed automatically toward the work. The flux is exposed to the high temperature developed during the welding operation and the slag is formed as discussed above. This method is most commonly used now.

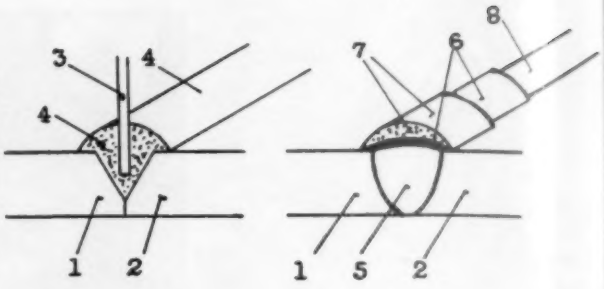

Figure 1.a — Start of welding; Figure 1.b — Weld Finished; 1, 2—Plates to be welded; 3—Electrode wire; 4—Powdered flux; 5—Weld metal; 6—Slag; 7—Remainder of powdered flux to be used again; 8—Surface of weld.

Figure 1-a. Figure 1-b.

Composition of Flux

(a) Coated electrode. The composition of the flux used in coated electrodes for automatic electric arc welding is similar to that of coated electrodes for hand welding. The subject is not discussed here in detail since it is covered in recent publications summarized by Spraragen and Claussen (2). It is not possible, of course, in large-scale production to use as an electrode on the welding machine a reel which is surrounded by a sheath of practically stiff material to hold the flux (e.g. asbestos, cardboard paper, fibre are used for hand welding rods). In order to permit the bending of the electrode, spirals of rather widely wound asbestos are used for holding the flux, or some similar arrangement is made.

(b) Bare-wire electrode and separate flux. Although powdered flux has been used for many years, the modern development of automatic electric arc welding may be dated from the patent issued in 1930 to Robinoff, Paine and Quillen, and assigned to the National Tube Co. of New Jersey (4). The patent gives few details regarding the composition of the flux, except to state that the flux should be magnetizable, containing, for instance, ferrous oxide. Most fluxes used for this type of work are a mixture of various raw materials, chiefly raw natural clay, such as is commonly used in making brick or pottery. It is possible to weld plates up to 5/8 in. in thickness in a single pass. The weld thus obtained is of satisfactory properties, and similar to welds made by hand.

Another patent in this field was secured by V. Miller in 1934 and assigned to the General Electric Co. of New York (5). The flux contains, for example, titanium dioxide—18%, feldspar—53%, raw bentonite clay—1%, sodium hydroxide—4%, sodium carbonate—2%, and water—22%. This is again a mixture of several raw materials which is used as a paste-like material on the welding machine. Tests show that results may be obtained similar to those obtained through use of the National Tube Co. flux.

The next important advance in fluxes for automatic electric welding is disclosed in the 1936 patent by Jones, Kennedy and Rotermund of Berkeley, Calif., assigned to the Union Carbide and Carbon Corp. of New York (6) (basic patent for the "Unionmelt Welding Process"). This patent discloses a flux composed, for instance, of CaO—31.24%, MgO—11.01%, SiO_2—52.40%, Al_2O_3—4.11%, and Fe_2O_3—0.13%. Whereas former patents make use of raw materials which are liable to give off water vapor, etc., under the intense heat of the electric arc, Jones and collaborators melt, in an electric arc furnace all raw materials for the flux prior to its use in the welding machine. This will prevent, during welding, the formation of vapor and gas which might lead to holes and porosity in the weld. The molten

flux is cooled and a glass of definite composition obtained which is ground to a fine powder. Halide salt, for instance 6% CaF_2, is usually added to this flux in order to improve the properties of the weld.

The flux is used on the welding machine in an arrangement similar to that described by Robinoff, Paine and Quillen. However, Jones, Kennedy and Rotermund state that the heat necessary for welding is not generated by an electric arc but "by the passage of a heavy electric current between a metal electrode (usually bare) and the metal plates or similar objects to be welded, the electrode being out of mechanical contact with the objects and the current being carried across the gap between the electrode and the objects by and through a conductive melt or welding composition having appropriate electrical resistance properties. The heat thus generated melts successive portions of the electrode and the molten material is deposited as weld filler material."

This flux will produce welds which are considerably improved over hand welds. Steel plates up to one inch and more in thickness may be welded in a single pass, or light plates may be welded at a high rate of speed.

Aluminous Flux

The latest patent in this field was issued to the writer in 1940 and assigned to the Western Pipe and Steel Co. of California (7). This so-called "aluminous flux" is obtained from pure clay of definite composition. It contains, for instance, Al_2O_3 — 57.6%, SiO_2 — 41.8%, and TiO_2—0.6%. The raw material is processed by heating it to a temperature of about 2200 deg. F., maintaining it at this temperature for a considerable length of time, and cooling the resulting anhydrous synthetically crystallized product. The material is powdered if necessary, a small amount of sodium fluoride being added in order to stabilize the electric arc and to improve the weld.

The flux disclosed in this patent has a melting point in excess of 3500 deg. F., whereas steel melts around 2500 deg. F. During welding a viscous envelop, which surrounds the arc while the metal is molten, affords excellent protection to the weld. The use of a flux of high melting point is contrary to the earlier belief that fluxes should melt at or below the melting temperature of the metal. The high melting point of the flux is responsible, at least in part, for the excellent properties of the weld.

Since both the raw materials and the processing of this flux are comparatively inexpensive, a product of reasonable cost is obtained. Welds carried out with the new flux are far superior to hand welds and equivalent to or better than those produced by glass-type fluxes.

Since completing work on the flux assigned to the Western Pipe and Steel Co., as disclosed in the above mentioned patent, further progress has been made by the author, leading toward a new flux which shows a further reduction in the cost of the flux, an improvement in the method of manufacturing the flux and an improvement obtained with its use.

Physical Properties of Welds

Table A is presented in order to give an idea of possibilities opened up by the new fluxes for automatic electric arc welding. The data are not strictly comparable from a scientific point of view, because they were obtained by different operators on different welding machines. However, they were obtained for the same type of steel in commercial operations using single-pass welds.

Summary

Recent developments in automatic electric arc welding now make it applicable to many problems which could not be solved by hand welding. Further development in this field is largely dependent upon fundamental research leading to a better understanding of the various factors involved in welding. Thanks are due to L. W. Delhi of the Western Pipe and Steel Co. of San Francisco, Calif., for granting permission to use certain data concerning the Western Pipe and Steel Co. flux.

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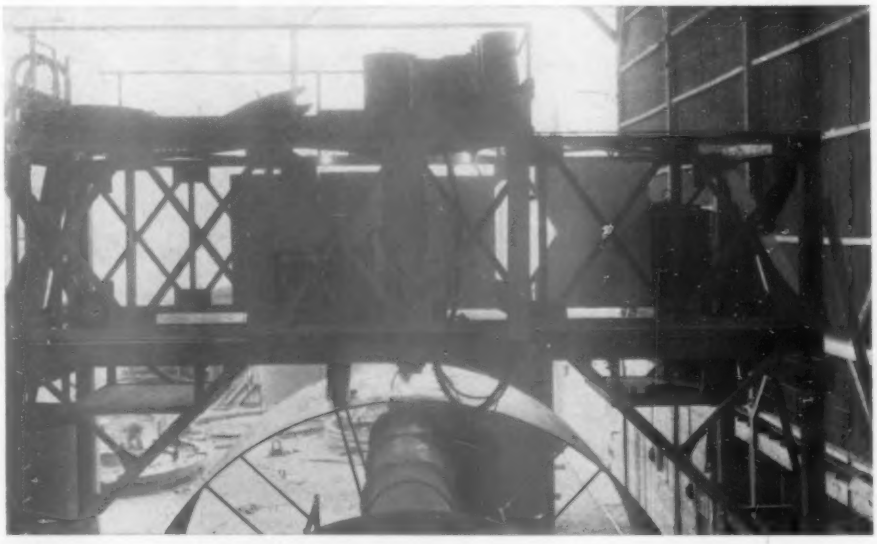
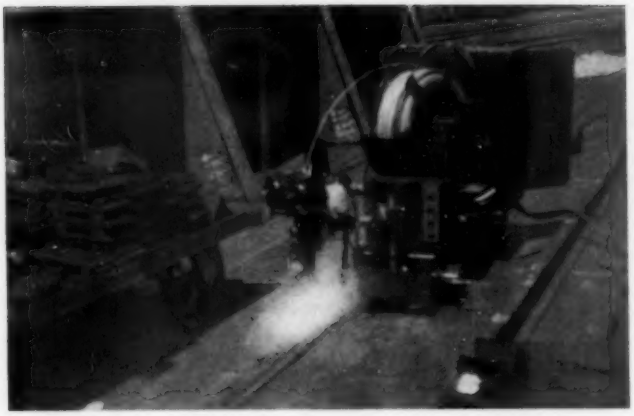
1. E. Lüder, Schmelzschweissung 10, 197-201, 220-222, 1931.
2. W. Spraragen and G. E. Claussen, Journ. Amer Welding Soc. 18, Suppl. 153-165, 1939.
3. P. Schimpke und H. A. Horn, Praktisches Handbuch der gesamten Schweisstechnik, vol. II, 2nd ed., Springer, Berlin, 1935.
4. U. S. Patent 1,782,316, 1930; B. S. Robinoff, S. E. Paine, W. E. Quillen.
5. U. S. Patent 1,978,316, 1934; V. Miller.
6. U. S. Patent 2,043,960, 1936; L. T. Jones, H. E. Kennedy, M. A. Rotermund.
7. U. S. Patent 2,194,200, 1940; W. M. Cohn.

Table A—Comparison of Physical Properties

Plates: Flange steel.	Electrode: Low carbon welding rod.			
Flux	Yield point psi	Tensile strength psi.	Elongation in % for 2 in.	Reduction of area in %
Unionmelt	40,150	66,720	37.1	62.1
Western Pipe and Steel Co.	49,860	72,110	32	51



Automatic welding has been used extensively in building large dams in the West. In this picture a large penstock for Grand Coulee Dam, Wash. is being welded using a flux developed by the author. Photo (Western Pipe and Steel Co.)



With the Unamatic arc welding machine, deck seams were welded at average speed of 35 ft. per hr.

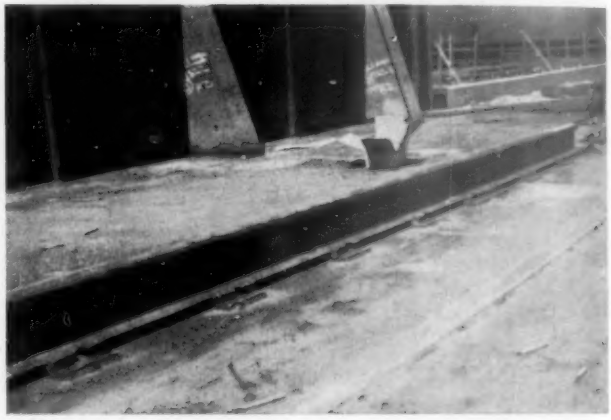
Automatic Welding Expedites Grade Separation Project

★ Probably one of the first applications of automatic arc welding in connection with bridge construction, was noted recently at a railroad-highway grade separation under construction at 79th St. and Kedzie Ave. on Chicago's southwest side. This project will eliminate two grade crossings by carrying the Wabash Railway main line and also two switching tracks over two very busy state highways. The structure was designed by the Wabash Railway Chief Engineer's Office, but its construction is being handled by the Dept. of Highways, State of Illinois.

There are two steel spans, one 130-ft. long over 79th St. and a second span 80-ft. long over Kedzie Ave. These are composite bridge structures assembled partly by riveting and partly by welding. A composite girder construction was used with butt welded seams in the web and riveted top and bottom chords. Vertical knee braces were then welded to these bridge girders. There was 16 ft. of manual welding on each knee brace and a total of 48 knee braces on the two spans.

The steel floor deck is completely welded to make it watertight, part of the deck being ⅜ in. low-alloy plate and part ½ in. corrugated plate. Recognizing the economies which might be realized by speeding up the butt welding of the 17 longitudinal seams on each bridge deck, the contractor* conceived the idea of employing a portable type automatic arc welding machine. After preliminary investigation, he decided to employ a 400-amp. Unamatic arc welder. This unit not only feeds the welding wire and arc shielding tape automatically, but also moves along the seam at the proper speed. This is accomplished by means of a small motor connected through a worm gear reduction unit. The control relays which function as the "nervous system" for this automatic machine, are mounted in a steel cabinet at the rear of the unit. Using a 7/32-in. Una processed welding wire, the contractor achieved an average welding speed of 35 lineal feet per hour using 300 to 325 amps. Wherever possible a ¼-in. backing up strip was first tack welded underneath the deck plates.

A carefully planned welding procedure was followed in welding the longitudinal deck seams in order to take care of weld metal expansion and shrinkage. First of all, all seams were butt welded before any of the plug welds were made to the floor girders. This permitted the plates to move under thermal stresses and avoided weld cracking. The outside two seams of the bridge deck were welded first and then the Una machine was moved to the center seam. Next the machine was operated along adjoining seams, working symmetrically outward from the center. To hold the plates in position for tack welding and also for the finish seam welding, the contractor used a ballast truck loaded with steel track fittings. In addition, heavy rails, were laid across the deck plates to hold them in position for welding.



Vertical knee braces were field welded to bridge girders. Rail fasteners were manually welded to the deck plate.

Power supply for both the manual and automatic arc welding was obtained from a 400-amp. Hobart gas engine-driven portable unit. This portable power plant included a belt-connected 3-kw. 220-volt 3-phase A-C. generator to furnish necessary power for operating motors and control relays on the Unamatic machine. In addition, the Hobart portable power plant provided a 110-volt D-C. tap, taken from the exciter generator, for operation of any portable hand tools which were needed on the job.

The bridge was constructed by the W. J. Howard Inc.-Western Welding Co., of Chicago, Ill.

*Western Welding and Boiler Repair Co., 1432 West Lake St., Chicago, Ill.

» «

The **Welding Engineering Co.** announce a new Training Division at 1119 W. Lake St., Chicago, Ill., for the purpose of training arc welders. It is planned to offer those interested a two-weeks intensified practical training course in arc welding at a low cost.

Fig. 9—Fabricating an Inconel airplane exhaust manifold. Note clamps for maintaining alignment.

Gas and

Electric Welding of

High Nickel-Bearing Alloys

★ Part 2*—Flame adjustment, Fluxes, Surface preparation, Welding Wire, Electrodes and Joint Design.

A SLIGHTLY REDUCING (carburizing) oxy-acetylene flame is recommended with just a little excess acetylene. There should be only a slight feather, no longer than $\frac{1}{16}$ in., showing beyond the tip of the luminous cone. With Inconel, the precaution should be taken to avoid too reducing a flame. A soft flame is preferable to a harsh or wild flame, such as occurs if too small a tip is used. In an oxidizing flame, copper (cuprous) oxide (Cu_2O) forms, in the case of Monel, and dissolves in the molten metal, rendering the alloy brittle and less resistant to corrosion. If an oxidizing flame is used, nickel is oxidized definitely and on Inconel, a chromium oxide is formed that is not soluble readily in the flux. A neutral flame would be preferable, but it is seldom that a set of regulators handled by the average welder will continue to give a truly neutral flame after a short period of use. There is usually some waver, either toward the oxidizing or the reducing side. Therefore, as a matter of safety, a slightly reducing flame is recommended.

*Part 1 was published in August, 1940 issue pages 30-33.

Fluxes

A flux is required for gas welding Monel and Inconel, except with the No. 43 Silicon Monel Gas Welding Wire. No flux should be used with nickel. The following fluxes are recommended:

For Monel—Monel Gas Welding Flux

For Inconel—Inconel Gas Welding Flux

The reasons for using a flux are: (a) to protect the metal from oxidation and to dissolve oxide, and (b) to improve the fluidity of the molten metal. Flux may be used as a dry powder into which the heated end of the rod is dipped or preferably as a thin paste. The paste is made by mixing the dry flux with alcohol or dissolving it slowly in very hot or boiling water in the case of Monel, and cold or warm water for Inconel flux. Monel flux should not be prepared in a glass container, because of the heat generated when the water and flux are mixed. When used in paste form the flux is painted with a small brush or acid swab, on both sides of the seam, top and bottom, and on the welding rod. This method is used most widely and satisfactorily on sheet and tube from .021 in. thick up to a max-

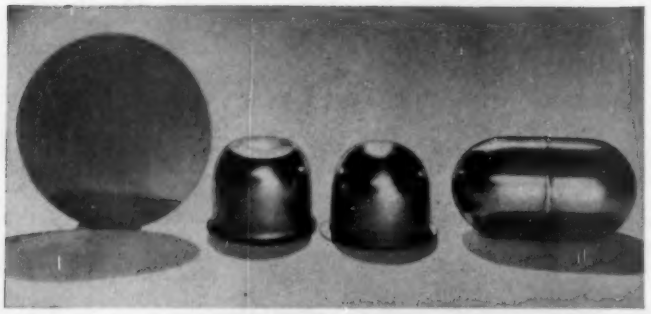


Fig. 7 — A welded gauge column float in different stages of production from blank disc to finished float. See Fig. 10.

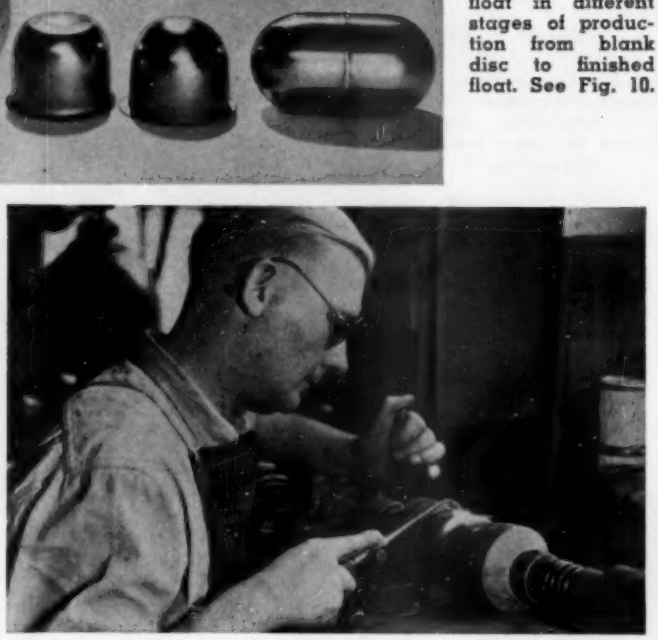


Fig. 8 — Welding together the two halves, or cups, of the gauge column illustrated in Fig. 7. This is done in a special lathe by melting down the flanges to form the weld. An oxy-acetylene torch with reducing flame is used. (Photo Reliance Gauge Column Co.)

imum of about ⅛ in. or $\frac{5}{32}$ in. thick. The gas welding of Monel rod and bar stock is done preferably with the No. 43 Silicon Monel Gas Welding Wire, no flux being used.

Borax is not recommended as a flux. It does improve fluidity of the molten metal, but has the drawback of causing low ductility in the finished weld. Furthermore, borax does not dissolve the metallic oxides sufficiently, and is rather difficult to remove after welding.

The recommended fluxes do not corrode the high nickel alloys and need not be removed on this account. However, it is usual to remove them as a matter of cleanliness. This is easily done on Monel by dissolving the spent flux in warm water. The spent flux is removed from Inconel either by sand blasting or by immersion of the gas welded piece in the following solution:

Solution to Dissolve Inconel Gas Welding Flux After Welding

Nitric Acid (HNO_3)—50% Solution (by weight)
Temperature—Room
Immersion Time—5 to 10 minutes
Rinse in clear water after cleaning.
Solution can be held in glass, earthenware, or other suitable non-metallic container.

Surface Preparation

Oxy-acetylene welding wires and fluxes for Monel, nickel and Inconel are designed for use on clean metal, such as standard cold rolled sheet, pickled hot rolled plate, or cold drawn rod. To insure satisfactory welding of hot rolled plate, hot rolled bar stock, or material which has been hot worked otherwise in processing or fabrication, it is necessary first to remove the thin darkly colored oxide film from the immediate vicinity of the area to be welded.

This can be done either by such mechanical methods as machining, sand blasting, grinding, rubbing by hand with emery cloth, or chemically by pickling. In machine beveling a hot rolled plate in preparation for a butt joint no further cleaning is needed, because the clean metal surface is exposed on the face of the bevel. However, if an attachment must be made by fillet welding to the surface of a hot rolled plate, not previously cleaned, the oxide must be removed, preferably by light grinding either with a disc, fine grit solid emery wheel, or rolled head wheel. If the oxide is not removed, difficulty may be encountered in welding.

Welding Procedure

The gas welding of all these materials goes along easily with correct fluxing of both sides of the joint, and with the flame adjusted to the slightly reducing conditions, Monel flows freely from the filler rod into the joint. Nickel, which is not fluxed, flows a little sluggishly. Inconel weld metal is neither sluggish nor very fluid.

The appearance of properly made gas welds is quite similar to that of good gas welds in steel. The surface is smooth, not rough or burnt, and the ripples are clearly distinguishable. In Monel, the ripples are spaced the same as in steel; in nickel and Inconel, the spacing is greater. Gas welds in Monel, nickel or Inconel, either in the aswelded or ground and polished conditions, are free from porosity.

In introducing a steel welding operator to the gas welding of nickel alloys it is often found that he "puddles" (boils) the metal excessively. For the best results on high nickel materials, puddling should be avoided; the molten pool should be kept quiet, with the tip of the luminous flame just touching its surface. Puddling burns out the deoxidizing elements which are important ingredients of these alloys, and will result in brittle and "gassy" welds. Extra caution should be exercised in this respect with nickel and high nickel alloys, because these materials absorb gases quite readily while molten

Fig. 10—Gas welded Monel chain for pickling steel. The double vee joint is gas welded without flux and with a No. 43 Silicon Monel gas welding wire.

and evolve them to form gas pockets on solidifying.

The proper size of tip is determined best by experience. Usually the same size or one size larger than that recommended by the torch manufacturers for similar gauge steel may be used. If the welding is progressing too slowly, it is logical that the flame size should be increased, either by increasing the flame size with the tip already in the torch or by changing to a larger tip. And conversely, if the welding is being hurried unduly and the weld metal is boiling instead of being quiet, obviously the heat should be reduced to avoid burning holes in the metal.

During welding the end of the welding rod should be kept always well within the protecting flame envelope; this prevents oxidation of the hot rod material. The tip of the luminous cone should contact the surface of the pool of molten metal, not only to prevent oxidation but also to obtain a concentrated heat.

Welding Wire

Welding wires are, in general, of the same composition as the alloy being welded. This is necessary to insure uniform corrosion resistance, without galvanic effects. Oxy-acetylene welding wire is bright annealed and free from oxide. It is furnished in standard lengths of 36 in. and in the diameters listed in Table 4.

Table 4—Oxy-Acetylene Welding Wires

Standard lengths: 36 in.
Standard Diameters: $\frac{1}{16}$ in., $\frac{3}{32}$ in., $\frac{1}{8}$ in., $\frac{5}{32}$ in., $\frac{3}{16}$ in. and $\frac{1}{4}$ in.

Material to be Welded	Oxy-acetylene Welding Wire to Use
Monel	No. 40 Monel Gas Welding Wire—Use with Monel Gas Welding Flux
	No. 43 Silicon Monel Gas Welding Wire—No Flux (For oxy-acetylene welding of Monel in large cross sections and for sulfuric acid and pickling equipment)
Nickel	No. 41 Nickel Gas Welding Wire—No flux is used
Inconel	No. 42 Inconel Gas Welding Wire—Use with Inconel Gas Welding Flux

It is important to use the size of filler wire that is best suited to the thickness of material to be welded.

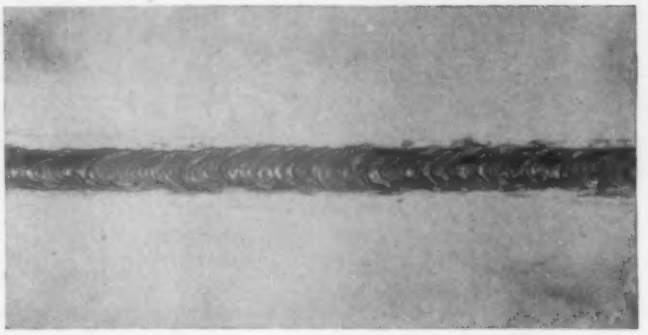


Fig. 11 — A Typical Monel arc weld made with No. 130X Monel electrode. Nickel and Inconel welds are similar in appearance.

Table 5 is a guide to the selection of wire sizes and to the estimation of quantities required.

Table 5—Gas Welding Wire Diameters vs. Sheet Thickness

Dia. of Gas Welding Wire	Sheet Thickness on Which Welding Wire Is Used	Ft. of Welded Seam per Lb. of Welding Wire
$\frac{1}{16}$ in.	.031 in. to .062 in.	85
$\frac{3}{32}$ in.	.062 in. to .109 in.	42
$\frac{1}{8}$ in.	.109 in. to .140 in.	21
$\frac{5}{32}$ in.	.140 in. to .187 in. ($\frac{3}{16}$ in.)	12
$\frac{3}{16}$ in.	.187 in. and up	9

Electric Arc Welding

Both oxy-acetylene and metallic arc welding produce satisfactory joints in Monel, nickel and Inconel. The choice of process, in which sheet steel practice is an acceptable guide, is determined, not by the material, but by the physical characteristics of the piece to be welded, namely, gauge of metal, design of the piece, and design of the individual joint. It is recognized that electric welding, if applicable, will produce less buckling than gas welding.

The electric arc welding of Monel, nickel and Inconel is done following practices in joint design, layout and welding manipulation similar to those used in making quality welds in steel. Joints are produced that are equivalent in corrosion resistance and strength to the parent metal.

Since the coefficients of expansion of Monel, nickel and Inconel are practically the same as that of steel, warping and buckling resulting from the welding operation will be essentially the same, or very slightly more, than obtained in similar steel construction.

Monel can be welded in all positions with the same facility as steel. While nickel and Inconel can be welded in any position, it is best that, when possible, work be positioned for downhand or flat welding.

Good properties are inherent in welded joints in the three high nickel materials, and no after treatment, either thermal or chemical (passivation), is needed or recommended to maintain or restore corrosion resistance. Thermal treatments, however, may be applied for special reasons, as, for example, a stress relief of a fabricated structure to meet Code requirements.

In general, the lower limit of thickness of sheet for electric arc welding is set at .050 in. (18 ga. U. S. S.) or .037 in (20 ga. U. S. S.), but through the recent introduction of rectifier type welders, gauges as light as .018 in. (26 ga. U. S. S.) have been welded with electrodes smaller than $\frac{1}{16}$ in. diameter.

Electrodes

Available electrodes and recommended applications are listed in Table 6. A guide to the selection of proper electrode size is given in Table 7.

Electrodes, which are of the shielded arc type, are made by extruding over a straightened and cut piece of Monel, nickel or Inconel wire, a uniform, concentric flux covering which is then dried on the rod. The flux contains ingredients which, during welding, produce a miniature electric furnace at the end of the electrode to protect the globules of melted core wire as they pass through the arc. This insures deposition of sound, strong, ductile weld metal. The melted flux coating, floating on the surface of the pool of molten metal during deposition, finally solidifies to a slag which is removed easily by hand tools.

The electrodes described have been designed for use on D. C. motor-generator or rectifier type welders, and produce satisfactory joints when so used. They will

Table 6—Electrodes and Recommended Applications

Electrode	Application
No. 130X Monel Arc Welding Rod...	Metal arc welding of all forms of wrought and cast Monel to Monel, Monel to steel, and nickel to steel. Also, for welding the Monel side of Monel-clad steel.
No. 131 Nickel Arc Welding Rod.....	Metal arc welding of all wrought or cast forms of pure nickel.
No. 132 Inconel Arc Welding Rod.....	Metal arc welding of all wrought or cast forms of Inconel. Also, for welding the Inconel side of Inconel-clad steel.
No. 135 Nickel Arc Welding Rod.....	Metal arc welding of nickel side of nickel-clad steel.

Table 7—Electrode Diameter vs. Sheet Thickness

Electrode Diameter	Approximate Number of Electrodes per Pound	Sheet Thickness on Which Electrode Is Used
.075 in.	32	Up to and including .062 in.
5/32 in.	23	.062 in., .078 in., .093 in.
1/8 in.	13	.109 in., .125 in., .140 in., .156 in.
5/32 in.	8	.140 in. and thicker
3/16 in.	5+	.375 in. and thicker, and for overlaying
1/4 in.	3+	Used for overlaying

not produce satisfactory welds when used on A. C. transformer type welders.

Electrodes should be left in the sealed bundles until they are to be consumed. As for coated electrodes of other metals and alloys, storage in a dry, cool place is recommended.

Diameters of 3/16 in. and smaller are the most widely used for welding. The 3/16 in. and 1/4 in. diameters are recommended for overlaying.

The high nickel electrodes are used only on reversed polarity, i.e., electrode positive, work negative.

Welding Currents

Each diameter electrode has an optimum amperage range in which it has good arcing characteristics, and outside of which the arc becomes unstable. The limits of satisfactory operation of each diameter electrode in each material are given in Table 8.

Table 8—Recommended Current Ranges for Inco Electrodes

Diameter of Electrode	Proper Current Range (in Amperes) No. 130X Monel	No. 131 and No. 135 Nickel	No. 132 Inconel
.075 in.....	25–40	35–55	30–45
5/32 in.....	45–60	65–85	45–60
1/8 in.....	60–95	80–110	60–95
5/32 in.....	80–150	120–170	100–135
3/16 in.....	140–260	160–210	110–195
1/4 in.....	170–260	.....	.....

A chart for making approximate initial welding machine settings for a given gauge of metal, and diameter of electrode is given in Table 9. Such variables as type of backing, whether steel, copper, cast iron, or no backing; tightness of sheet in clamping device, and type of joint make it difficult to set exact currents. The table should be used, therefore, only as a guide. It is not intended to replace the sound judgment of the welder.

Joint Design

The wide variety of joint types which are used in the fabrication of Monel, nickel and Inconel by electric arc welding are illustrated in Table 10.

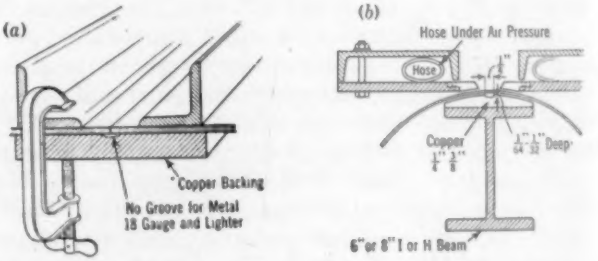


Fig. 12—Jigs used for arc welding butt joints in Monel, Nickel and Inconel.

Table 9—Approximate Amperages vs. Sheet Thickness

It is difficult to specify the exact amperage for a given sheet thickness because of many variables involved. This table is only a *guide* and *judgment should be used.*

MONEL Thickness of Sheet Inches	MONEL Diameter of Electrode Inches	MONEL Amps.	NICKEL Thickness of Sheet Inches	NICKEL Diameter of Electrode Inches	NICKEL Amps.	INCONEL Thickness of Sheet Inches	INCONEL Diameter of Electrode Inches	INCONEL Amps.
.500 (1/2) and up	3/16*	190	.187 (3/16) and up	5/32	150	.375 (3/8)	3/8	140
.375 (3/8)	3/16*	170	.156		135	.187 (3/16)	5/32	130
.250 (1/4) and up	5/32	150	.140		130	.156	1/8	80
.156		115	.125 (1/8)		110	.125 (1/8)		75
.140		110	.125 (1/8) and .109	1/8	90	.109		65
.125 (1/8)		100	.093	5/32	85	.062 (1/16)	5/32	60
.156		95	.078		80	.050	.075	50
.140	1/8	85	.062 (1/16)		65	.045		45
.125 (1/8)		75	.043 and .050	.075	60	.037		30
.109		65	.037		55			
.093 and .109		60						
.078	5/32	55						
.062 (1/16)		50						
.050		45						
.062 (1/16)		40						
.050	.075	35						
.043		30						
.037		25						

*1/4 in. diameter is used for overlaying, and 3/16 in. diameter for welding and overlaying.

Table 10—Electric Arc Welding Data for Monel, Nickel and Inconel

Joint Type 100% Penetration is Assumed	Minimum and Maximum Gauges (U.S.S.) for Various Positions		Root Spacing "S" Between Plates in Column 1		Joint Backing—(Copper Bars Are Preferred)	Tack Welds	Electrode Diameter*		No. of Passes Required to Complete the Joint	Electrode Positions for Downhand Welding End and Side Views
	Min.	Max.	For Min. Gauge	For Max. Gauge			For Min. Gauge	For Max. Gauge		
Column 1	2	3	4		5	6	7	8	9	10
SQUARE BUTT	(f) .037″ (20 ga.)	.125″ (11 ga.)	0	1/16″	Backing is necessary for gauges .050″ (18 ga. U.S.S.) and thinner — If design permits, backing should be provided for gauges .062″ (16 ga. U.S.S.) to .093″ (13 ga. U.S.S.)	1/8″ Long on 3″-4″ Centres	.075″	1/8″	1	Electrode, Electrode Travel
	(v) .062″ (16 ga.)	.125″ (11 ga.)	0	1/16″			.075″	1/8″	1	
	(o) .050″ (18 ga.)	.125″ (11 ga.)	0	3/32″			3/32″	1/8″	1	
SINGLE "V" BUTT OR SINGLE "V" (WITH LIP) BUTT	(f) 5/32″ (9 ga.)	5/16″	1/16″	3/32″		1/4″-1/2″ Long on 6″ Centres	1/8″	5/32″	1 for 5/32″ or 3/16″ Plate 2 for 1/4″ Plate 3 for 3/8″ Plate 3 or 4 for 7/16″ & 1/2″ Plate	
	(v) 5/32″ (9 ga.)	3/8″	1/16″	3/32″			1/8″	5/32″		
	(o) 5/32″ (9 ga.)	5/16″	1/16″	3/32″			1/8″	5/32″		
	(f) 5/32″ (9 ga.)	1/2″	1/16″	1/8″		1/4″-1/2″ Long on 6″ Centres	1/8″	3/16″		
	(v) 3/16″ (7 ga.)	7/16″	1/16″	1/8″			1/8″	3/16″		
"U" GROOVE BUTT	(f) 1/2″	No Max.	1/16″	3/32″		1″ Long on 8″ Centres	1/8″	5/32″ & 3/16″	Depends on Plate Thickness	30°, 30°, 20°
	(v) 1/2″	No Max.	1/16″	3/32″			1/8″	5/32″ & 3/16″		
LAP	(f) .037″ (20 ga.)	No Max.	None			3/4″ Long on 6″ Centres	.075″	5/32″ or 3/16″	1 or More	40°, 20°
	(v) .062″ (16 ga.)	No Max.	None				.075″	5/32″ or 3/16″		
	(o) .062″ (16 ga.)	No Max.	None				.075″	5/32″ or 3/16″		
FILLET	(f) .062″ (16 ga.)	No Max.	None			1/4″-1/2″ Long on 6″ Centres	3/32″	5/32″ or 3/16″	1 or More	45°, 20°
	(v) .062″ (16 ga.)	No Max.	None				3/32″	5/32″ or 3/16″		
	(o) .062″ (16 ga.)	No Max.	None				3/32″	5/32″ or 3/16″		
CORNER	(f) .050″ (18 ga.)	1/8″ (11 ga.)	None			1/4″ Long on 4″ Centres	.075″	1/8″	1	15°, 20°
	(v) .062″ (16 ga.)	1/8″ (11 ga.)	None				.075″	1/8″	1	
	(o) .062″ (16 ga.)	1/8″ (11 ga.)	None				.075″	1/8″	1	
CORNER	(f) 3/32″ (13 ga.)	No Max.	None			1/4″ Long on 4″-8″ Centres	1/8″	5/32″ or 3/16″	Depends on Plate Thickness	45°
	(v) 3/32″ (13 ga.)	No Max.	None				1/8″	5/32″ or 3/16″		
	(o) 3/32″ (13 ga.)	No Max.	None				1/8″	5/32″ or 3/16″		
	(f) .037″ (20 ga.)	.062″ (16 ga.)	None			1/8″ Long on 4″-8″ Centres	.075″	3/32″	1	Same as for Square Butt (at top of table)
Bead Only to Sound Metal	(f) .031″ (22 ga.)	.050″ (18 ga.)	None			1/8″ Long on 4″-8″ Centres	.075″	3/32″	1	Same as for Square Butt (at top of table)

(f) = Flat Position
(v) = Vertical Position
(o) = Overhead Position

Fig. 1—The gas welding department is well lighted and ventilated, in addition to being thoroughly equipped to accommodate 32 students each training period.

Training Aims at Developing Basic Skill

By S. J. SLATER*

★ In March, 1938, New England Welding Laboratories, Inc. opened in Boston, Mass. with an initial enrollment of 8 students. At the close of May, 1940, it is filled to near capacity, with approximately 450 enrollments. The growth of this institution is undoubtedly due to the sound planning and far-sighted management of George R. Singleton, who, as president and managing director, has guided the school's activities from the beginning. Mr. Singleton was for many years a commissioned officer in the United States Navy, specializing in engineering. After leaving Naval Service and entering civilian life, he was attracted to this activity by the conviction that there is a good future in industry for young men properly trained in the art and technique of this important branch of metal fabrication.

The school's curriculum includes courses in Electric Arc Welding, Oxy-Acetylene Welding, Blue Print Reading, Drafting and a special course in Aviation Welding. In the Welding Courses, as applied to steel and cast-iron welding and brazing, butt and fillet welds are covered in the flat, vertical and overhead positions. The purpose here is to concentrate on the operations which are most prevalent in application and to avoid distracting attention from the fundamentals of proper torch and arc manipulation. It is the school's theory that by acquiring familiarity with the behavior of the commonest metals under the influence of both the torch and the arc, in the most frequently encountered joint types, the student gains a close understanding of what is going on during the welding operation, and that such understanding enables him to broaden the extent of his skill without difficulty when his employment demands it.

In short, the emphasis is placed on the building up of a basic skill. Progress is systematically checked by having the student weld standard specimens for tensile and ductility tests and weld soundness tests.

Individualized training is accomplished by grouping students according to aptitude, for both laboratory and classroom work, and by limiting each instructor to five students in any one period. The more gifted students are not held back and the slower ones are not put to any disadvantage. In the laboratory, only one student is permitted to work at a gas welding table, or in an arc welding booth, during each period, giving him the maximum use of both time and equipment and preventing him from acquiring undesirable welding habits from other students. Close personal supervision of student progress makes the coverage of pertinent subject matter and exercises secondary to the development of manual proficiency.

The course in Mechanical Drawing and Blue Print Reading is laid out primarily around the requirements of industries in metal fabrication, and includes both layout and design. The special course in Aviation Welding has recently been added to the curriculum. This course includes the welding of stainless steel, chrome and aluminum alloys and is given strictly in accordance with the requirements of the aviation industry. Each student must pass the tests set up by the Army, Navy and Civil Aeronautics Authority before receiving the school's certificate.

Equipment for welding instruction comprises 32 gas welding stations and 32 arc welding booths. All of the equipment is new and of modern design and represents several standard makes. Equipment also includes hand-cutting torches, a Radiagraph for instruction in machine cutting, an acetylene generator for demonstration purposes, a milling machine, steel cutting band saw, motor-driven grinders and a complete assortment of small tools, jigs, etc. The testing equipment includes an Airco tensile testing machine and a guided root-bend testing machine. Altogether the investment in fixed equipment is between $40,000 and $50,000. The school is located in the heart of the educational center of Boston, housed in a modern concrete and

(Continued on Page 32)

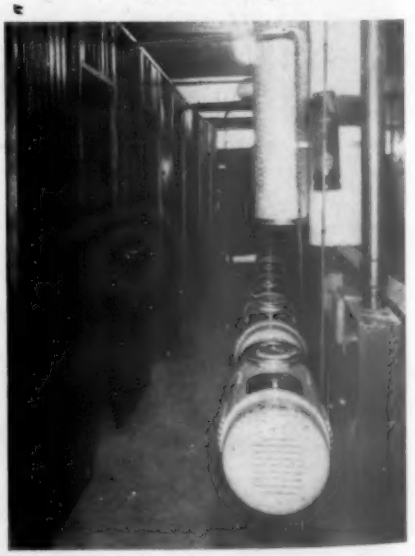


Fig. 2—An aisle of arc welding booths at New England Welding Laboratories. Cables are carried overhead to the booths for safety. The large ducts are part of the air conditioning system which changes the air completely every three minutes.

*Air Reduction Sales Co.

Fig. 1—Power-driven jig for welding seam on a washing machine tub. Welding tip is fed automatically along seam. A roller follows the torch to keep metal from buckling during welding.

Basic requirements of production jig's for

Oxy-Acetylene Welding

★Simplicity of design, convenience, visibility, rigidity, durability, heat control, clamping pressure, costs, are most important considerations.

By JOHN HAYDOCK*

WHEN A WELDER comes up against a job that needs a jig of some kind, he is often able to make one himself. In jobbing work, particularly, he frequently takes his torch and a few pieces of scrap metal to rig up something that will serve his purpose. This may not be engineering, but it saves the time that would have been necessary to get a jig designed in the engineering department. The jig may not look like much, when it is finished, but often it enables the welder to turn out a satisfactory job without bothering anybody else.

In the machine shop, practically all jigs and fixtures today are designed by tool engineers. A man operating a milling machine or boring mill is usually not in a position to make his own fixtures, as he must depend on someone else for his material and his designs. On the other hand the welder has an assembly tool in his torch. It is always handy and very often he is able to put something together without saying anything to anybody about it.

Sometimes this is an advantage, and sometimes it is not. If the welder is intelligent and understands the basic principles of jig design, he can usually do a pretty good job. On the other hand, where production quantities are involved, a well-engineered jig is often worth the additional time and trouble needed to lay it out on paper. This also holds true for general purpose jigs so designed that they can be used on a wide variety of short-run work.

Letting the operator improvise his own jigs may at first glance seem to be the easiest way to do it. It must be remembered, however, that when he is making jigs his time is lost for productive work.

*Digest of paper presented at 40th Annual Meeting of International Acetylene Association, Milwaukee, Wis. *The author is managing editor of American Machinist, New York City.

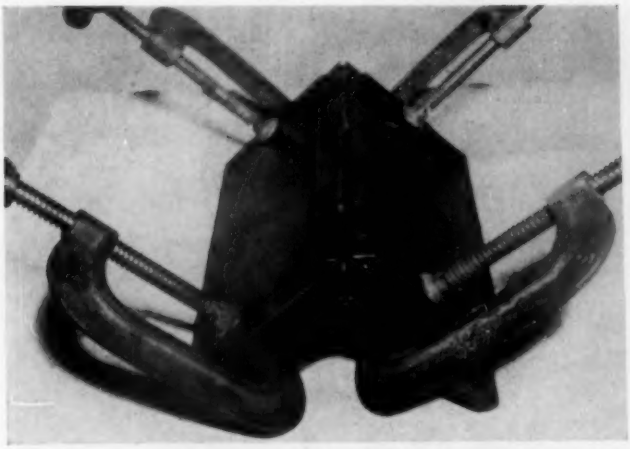


Fig. 2a—In making a corner weld, an angle iron with corner cut away may be used for a base plate. Clamping plates are beveled to give operator more room to manipulate torch.

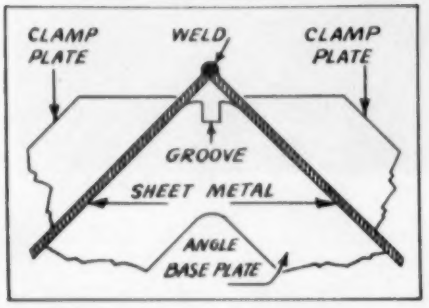


Fig. 2b—Cross-section of simple angle iron jig for making corner weld in thin sheets.

He may spend a good deal of time looking around for suitable pieces of scrap and then fabricate something that does not work out as he expected.

The ultimate solution is, of course, to do the planning for the man at the torch. On production work especially, problems of welded fabrication should be anticipated with all necessary jigs drawn up and built before the job is started. Good planning of this kind will save time and money in the long run. This is not to say that the improvised jig should not be used in the job shop, as unforeseen difficulties arise.

Attempts have been made in the past to distinguish between the terms "jig" and "fixture" as applied to welding. These terms are borrowed from the machine shop, but even here the distinction is far from definite. We can make definitions, but there will be many border-line cases and many exceptions. What is called a jig in one shop is a fixture in another. In welding, there is even less excuse for the two terms than in the machine shop. So, to simplify matters for the purpose of this paper, all such devices will be called jigs.

Having thus easily disposed of fixtures, what is a jig? It is a device designed to facilitate the process of welding and to improve the quality of the product by holding the work pieces in proper relationship, by positioning them to afford ready access to the welded sections, and by limiting the adverse effects of heating and cooling.

Welding jigs necessarily differ greatly from those used in the machine shop. One big difference is the change in temperature with its resultant expansion and contraction. Welded work is usually bulkier than that found in the machine shop.

The subject of oxy-acetylene welding jigs will be considered in two steps: (a) the basic requirements involved, and (b) the application of these principles as they are worked out in practice. The basic requirements of a well-designed welding jig are:

1. Simplicity. This is the basis of all good design. If a jig is simple it will be easy to make and easy to manipulate. In this field of work there is no excuse for complicated designs.

2. Convenience. The work must be held in position to make a good weld. Downhand welding is usually easier, but it is not always possible to get all surfaces in this position. Moving jigs are often used to bring various parts of the work piece successively into handy reach of the operator. The motion of such jigs is supplied by hand in some cases, and by power in others.

3. Visibility. Besides getting at the work, the welder must be able to see it clearly, if he is to turn out a high quality product. All jig designs must meet this requirement if the jig is to be of any practical use. Consequently, all gripping plates or brackets must be placed so they will not interfere with the operator's vision.

4. Rigidity. Like all jigs the welding jig must be strong enough to withstand deflection, or at least deflection beyond allowable limits. It should be remembered, however, that for thin gages of metal, it is necessary to allow slippage of the stock rather than to hold it rigidly.

5. Durability. Jig designs for repetitive work must have wear surfaces that will stand up in usage. Where the jig is made for a single job or for a short run of work, this factor is naturally of less consequence.

Fig. 3—Hoe welding jig. Operator can turn out an average of more than three bronze welded joints per min. Joining .20% carbon steel shank to .40% carbon steel blade.

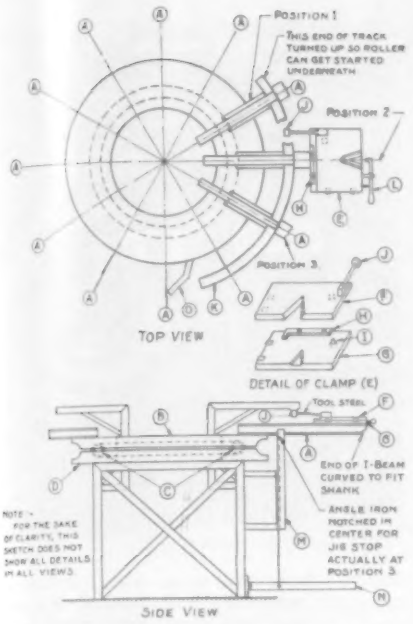

POSITION 1
THIS END OF TRACK TURNED UP SO ROLLER CAN GET STARTED UNDERNEATH
POSITION 2
POSITION 3
TOP VIEW
DETAIL OF CLAMP (E)
TOOL STEEL
END OF I-BEAM CURVED TO FIT SHANK
ANGLE IRON NOTCHED IN CENTER FOR JIG STOP ACTUALLY AT POSITION 3
NOTE:- FOR THE SAKE OF CLARITY, THIS SKETCH DOES NOT SHOW ALL DETAILS IN ALL VIEWS.
SIDE VIEW

Fig. 4—Welding is performed by an operator and a helper. The helper at Position 1 puts the parts of the hoe into the jig. The operator at Position 3 bronze-welds the joint. At Position 2, the jig comes under an oxy-acetylene flame which strikes the joint and preheats adjoining metal.

6. **Heat control.** A welding jig must be able to carry away the heat from the torch and in addition hold the work so that it will not buckle or overlap. It is well known that as the welded metal cools, contraction sets in. If a long seam is welded in light gage sheets, it is necessary to start the weld with the two edges at a slight angle. Then, as the weld progresses, the sheets will be brought together without overlapping. This contraction requires some motion in the sheets and it is necessary to provide for slippage in the clamping members. In some jigs a spacing piece is used which is moved along as the weld progresses to keep the two edges the proper distance apart. In jig design it should always be remembered that the clamping surfaces act as chills which aid the work piece itself in conducting heat away from the weld. Sometimes the jig is water cooled or provided with copper inserts to speed up this process. However, the chilling surfaces should not be so close to the weld that they will interfere with complete fusion.

7. **Protection of work.** On some work, particularly on aluminum and stainless steel sheets, it is important not to mar the surface. For this reason, jigs must be designed so that the clamping fingers will hold the work without scoring it. Soft pads of asbestos or other material are used to protect the work in some instances.

8. **Clamping pressures.** This requirement is closely associated with heat control and protection of the work. A few welding engineers have gone so far as to figure deflection in the jig base and in the clamping fingers to produce excellent results. More often the clamping pressure is arrived at by a cut-and-try method, or on the basis of past experience. A good workable solution of this question has much to do with the success of the jig.

9. **Cost.** The cost of welding jigs must be considered on the basis of that of any piece of new equipment. An estimate should be made of the time saved per piece, the number of pieces to be made, and the possible future use of the jig. Balanced against this is the cost of the jig itself. In short, no jig is justified unless it will pay for itself within a reasonable time. However, sometimes jigs are necessary in order to get the job done at all, or in order to hold it to specifications. Where the quality factor dictates the use of a jig, there is no alternative but to use one. When figuring on exacting jobs, the cost of welding jigs should be included along with production costs in arriving at the final estimate.

10. **Storage facilities.** A shop using a lot of jigs must figure on storage space. Otherwise it will be crowded with bulky units, used only occasionally, causing considerable inconvenience. With a little ingenuity, a great many jigs can be designed so they can be dismantled into relatively flat units and put away without taking up much room.

So much for the general considerations of welding jig design. The jigs themselves may be roughly divided into three classes; stationary jigs, hand-operated jigs and power-operated jigs. The simplest jigs are usually made up of structural shapes, together with C-clamps. Such clamps are cheap to use because they can be employed over and over again on different jobs, but they are not quick operating and consequently do not afford the best solution on production runs. Toggle clamps are quick acting and when properly designed will exert close control of pressure. Spring clamps, wedges, H-clamps, knobs and bolts are some

Fig. 6—This jig locates the various parts of a complicated assembly, while they are welded together. Employed by Servel for connecting the evaporator with gas heat exchanger and absorber. Cylindrical parts of assembly are held in V-blocks by means of toggle clamps.

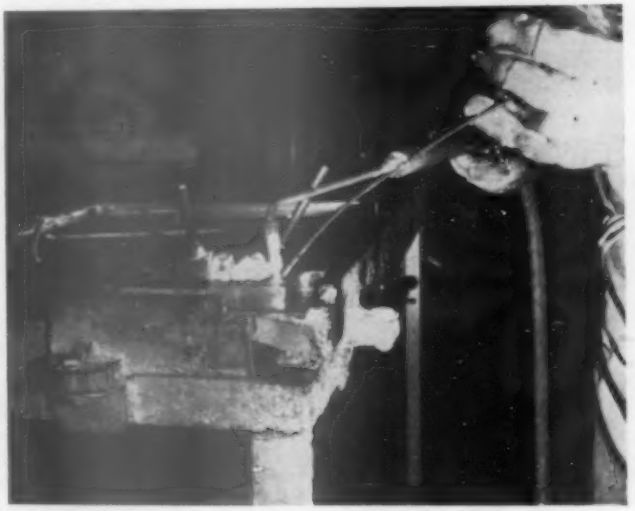


Fig. 5—Jig used for welding aluminum screens and window sash. Comprises an iron table with two eccentric clamps at the corner. Sides of table at the corner are squared off to hold frame in proper position.

of the common means of holding work in place. Each type must be considered in connection with a particular job.

Hand-operated jigs range all the way from a simple mandrel on which the work is revolved to some extremely complicated devices. Some of the simpler types consist of the horn jigs for cylindrical work, turntables, trunnions, face plates, and spiders for holding the work internally.

Power, either electric or pneumatic, is frequently applied to the same kind of jig that is hand-operated in its simpler form. The application of power is always a question of judging between increased production and increased cost of the jig. Power-operated jigs are becoming more popular as welding is used in an ever widening field and on increased production lots. Power may be applied merely to clamp the work in place and to release it after the welding has been completed; or it may be used to move the work, either intermittently or continuously, as the welding operation progresses. In such cases it greatly expedites the operation by giving an opportunity for almost continuous welding. Power clamping removes the human element in setting up a job by eliminating variations in clamping pressure.

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Fig. 2—Front-door-open view of instrument for recording both normal and abnormal time of arc operation.

Instruments for Checking Operator Performance

By ROBERT E. KINKEAD*

THE PURPOSE of instrumentation in manual arc welding is to study the behavior of the man, not the machine. This is in contrast to the instrumentation of an automatic process like Unionmelt, or in modern spot welding of aluminum and stainless steel in which the instruments are used to tell what the process is doing, and the man is only a factor insofar as he sets the instruments according to a table. Since more than 95 per cent of all arc welding is carried out by manual operation, the problem of studying operator behavior is a serious one. The welding machine and the welding rods have invariable operating characteristics which are built into them. The operator, on the other hand, has a behavior pattern which is the most variable of any factor involved in the production of welded construction.

While we are concerned in many cases with variation in the quality of the man's work, steady improvement of welding machines and welding rods has given a fair degree of uniformity of quality of welding. The problem of instrumentation of manual arc welding is mainly one of studying operator behavior with the end in view of getting more production and at the same time improving quality. Improvement of quality of work due to instrument checking is well known and applies to welding as well as to other production operations. The old idea of getting production by setting piece work rates and paying a bonus for all production over a minimum is not as satisfactory as it might be. Under these circumstances it frequently happens that the rate is set too high because insufficient information is available as to what can be accomplished. The operators then start earning large bonuses, necessitating resetting the rate two or three times within a year and disturbing shop labor relations to a punishing degree. A man with a stop watch and usual time-study methods, but without a background of welding knowledge, can get management into a great deal of trouble in a very short length of time. It has happened many times within the personal experience of the writer, although it is only fair to state that one of the highly developed systems for paying bonuses has been applied successfully to manual arc welding practice. It is the author's belief that the knowledge of what can be accomplished in terms of increased production should be more widespread among employers of manual arc welding operators, and that this knowledge can be obtained more accurately and for less cost by instrumentation and by study of the employer's own problems than by any more or less fixed system. Nothing succeeds like increased knowledge on the part of large numbers of people.

It is only necessary to mention briefly some of the things that have been found to affect operator production, to reach the conclusion

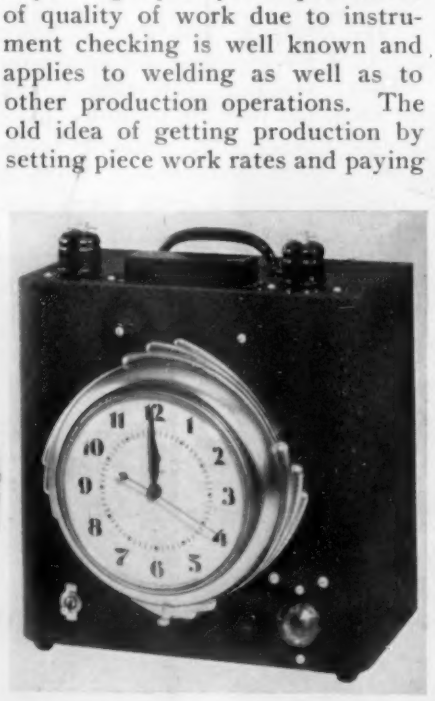


Fig. 1—Electric clock type of instrument for recording normal arc operation.

*Consulting Engineer (Welding), Cleveland, Ohio.

that some means of measuring the effect of these variables is needed. For instance, an operator working in a closely confined space will deposit on the average from 30 to 35% less metal per hour than he will in an open space. Speed of production is, of course, reduced in many cases as much as 80% by changing from the straight down position of welding to vertical or overhead welding. The length of the welding rod in relation to the current being used for a given size will change the operator's production as much as 20%. A hot holder or a shield which does not give proper ventilation may change an operator's production by as much as 25% in an 8-hr. period. Improper body protection, including gloves, may produce nervous fatigue during the first 4 hours of a shift which will pull the operator's production down by as much as 30% during the second 4 hrs. of the period. Poor fitting up of the work with the consequent difficulties in getting the initial beads welded in will use up the operator's energy at an extremely high rate and pull his production down to very low levels, purely aside from the loss due to the extra weld metal required by poor fit up.

Some Incentive Needed

Lack of incentive to get high production is, of course, a dominating factor. So far as my observation goes, the manual welding operator is actuated by the same incentives as the president, the general manager, or any other official of a company. He will do a comfortable day's work, and it will be a very comfortable one, unless there is some incentive to do a good day's work. But in providing an incentive to do a good day's work, safety lies in the direction of dealing with measurable factors rather than blunderbuss methods which lead to dissatisfaction on the part of the operator as well as the management.

Readily observable variations in production from shop to shop of as much as 300% may be found. What this wide variation means is that one operator in a certain shop is getting as much work done as three operators in another shop and he may not be working any harder to

Fig. 3—Front panel view of precision instrument for recording normal and abnormal time of arc operation on any one of 19 arc welding circuits.

do it. It seems that this is a far more important factor, than whether an operator is wasting 15 or 18% of his welding rod in stub ends, or whether he is saving power by shutting his welding machine down when he is not using it. It is all very well to give a man a large rod and tell him to use all the heat the job will stand, but from the management point of view the important factor is to get the most production from the amount of effort the operator may be reasonably expected to expend on the job. Within the experience of the author, many shops fail to realize the production that can be obtained with high current welding, merely because they have no way of measuring operator behavior under the conditions surrounding the work. Instruments have been developed for this purpose, in addition to improving quality, by continuous checking as described herewith.

One of the simplest methods of beginning a study of operator behavior is to put an instrument on the machine that will record accurately the time the operator has the arc in normal operation. Such an instrument is illustrated in Figure 1 and permits such studies hour by hour throughout the day. It also permits the study of the effect of having the operator do fitting up work in addition to welding. From such studies the economical balance can be established between operation of the arc and other manual labor connected with fitting up. Increases of production per man-hour of as much as 50% may be the outcome of such studies. It is a well known fact that there is a limit to how many hours per 8 hour turn an operator can operate an arc. While this factor varies between individuals, no incentive system will ever have a sound basis unless factual information of this kind is available.

Figure 2 shows an instrument which records the time of normal arc operation of the manual operator and also the time in which he had the arc in operation, but was not operating the arc in a normal manner. Such an instrument is used in studies of the effect of positioning on welding operator production; studies of the progressive effect of highly fatiguing welding operations.

Figure 3, shows an instrument for precision measuring of operator performance with any kind of welding rod and records elapsed time, time arc is in normal operation, and time it is in abnormal operation.

Indicating Handshield

The shield shown in Fig. 4 has a red light and green light, and these lights may be attached to the type of instrument shown in Fig. 2 or Fig. 3, so that in training a beginner, the instrument will show him by the green light when he is operating in a normal manner. As soon as he operates the arc in an

(Continued on Page 40)

Fig. 4—Shield with green and red lights to indicate normal and abnormal arc operation.

Forward view of Ingalls-built vessel showing where ready-assembled prow sections are welded in place. At right may be seen a runway by which workmen may reach the top deck or any of the intermediate scaffolds.

Ingalls Builds All-Welded 12,000-Ton Cargo Ship

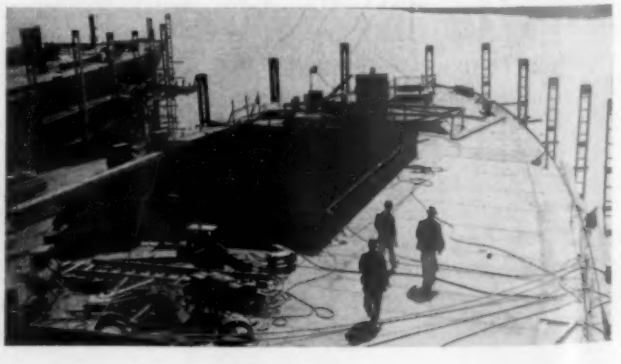
★ The first of eight all-welded cargo ships, part of a $20,000,000 contract for the U. S. Maritime Commission, was recently launched by Ingall's Shipbuilding Corp. at Pascagoula, Miss. The new smooth-skinned hull is designed to carry greater loads at higher cruising speeds with fuel consumption reduced by elimination of overlapping hull plates. The ship recently launched was christened the S. S. Exchequer and went into the service of the American Export Lines. It was built at a cost of about $3,000,000 and has a freight capacity of 12,000 tons and accommodations for 12 passengers in addition to crew. The welded ship weighs 6,000 tons and its displacement at maximum draft is 17,600 tons.

Close up of welder at work

It is generally agreed that an all-welded ship is 7 to 11% lighter than a riveted design. Furthermore, the butt-welded plates add a knot-an-hour to the ship's speed, because of lower friction loss. The ship in its trial run was reported to have made 16.5 knots per hour. The shipbuilding plant at Pascagoula, Miss., is a wholly-owned subsidiary of Ingalls Iron Works of Birmingham, Ala., and was completed in February, 1939. The present plant includes a plate and angle shop, a furnace and forge shop, a power plant and a number of other accessory units.

As in the case of most welded ships the vessels are fabricated in the form of sub-assemblies as much as possible. In building the stern, for example, the frame work is assembled separately, hoisted into place by cranes, and then welded to the body of the ship. For production welding, the shipyard uses two 1,200-amp. automatic machines propelled on a power driven carriage. On the thickest plate (7/8 in.) this machine travels at the rate of 9 in. per min. using 900 amp. of current. The majority of welding, however, is done by single-operator welding machines.

To meet the need for welders, the company maintains a welding school where young men in the community around Pascagoula are given intensive training under direction of qualified instructors.



Sternward view of one of the vessels under construction showing cargo hatches.

» «

Training Procedure

(Continued from Page 26)

steel building, and utilizes about 12,500 sq. ft. of floor space.

Students are not guaranteed positions, but the school maintains a Placement Bureau and keeps accurate records of each student's qualifications, and assists them in every possible way to obtain employment. This applies only to those students who have finished the course and have passed the generally recognized tests. It is reported that alumni records to date show that at least 90% of the school's graduates are employed.

Each student making application for enrollment is accepted on probation and, unless aptitude and sincerity of purpose are shown, he is not allowed to continue his course and his money is refunded. The school also refunds tuition to any student who is not satisfied and expresses his unwillingness to continue the course.

» «

Norwalk Compressors—In a new 32-page catalog the **Norwalk Co., Inc.**, S. Norwalk, Conn., describe their complete line of high pressure compressors. Some of the compressors described in Catalog No. 37 will be of particular interest to the oxygen producers because of their high working range—2000 to 6000 p.s.i.

A New Editor for The Welding Engineer

T. B. Jefferson

Theodore B. Jefferson has been appointed editor of *The Welding Engineer* to succeed **Ralph S. Kenrick**, editor since August 15, 1937, who resigned this position effective August 30, 1940.

"Ted" Jefferson comes to *The Welding Engineer* after having spent the greater part of the past nine years in close contact with the welding industry, both from the standpoint of welded design and the practical application of welding.

For the past seven years, Mr. Jefferson has been a mechanical and welding engineer on the civilian staff of the United States Army Engineer Corps. The past 18 months of this period has been as an engineer responsible for the welded design in the Marine Design Division of the Philadelphia Engineer Office and the Office of Chief of Engineers, War Department, Washington, D. C.

Prior to 1939 "Ted" Jefferson was assistant plant engineer on the U. S. Army's $120,000,000 Fort Peck Dam Project. In this capacity ,on this huge construction job on the Missouri River in Northeastern Montana, he was in direct charge of the U. S. Engineer Shops. Included as a part of the shops was a welding shop that became known as the world's largest hard-facing shop; this same shop was also one of the largest shops in the world engaged primarily in maintenance welding.

Mr. Jefferson's previous experience also included two years as assistant chief engineer of the Jefferson Wire and Iron Co., Kansas City, Mo. and one year as operations manager of the Missouri Valley Aero Club of the same city.

A native Kansan, "Ted" Jefferson was graduated from the School of Engineering, University of Kansas, 1930, and received a graduate degree of Mechanical Engineer from the same institution in 1938. He has also received special training in welding engineering through a course taken at John Huntington Polytechnic Institute, Cleveland, in 1936.

Welded Redesign Saves 45% On Cost of Engine Oil Pan

★ Very interesting and profitable results are frequently produced when consideration is given to ease of assembly and welding, in addition to preparatory machine work, etc. in the manufacture of welded products. An instance of this was the redesign of an oil pan by the foreman of the welding department at the Buda Co., Harvey, Ill. A cost saving of 45% resulted from easier assembly and welding made possible by the new design.

Parts of the pan consist of the following: 2 steel castings, one each on front and rear ends; 1 bottom sheet of 12-gauge annealed steel; 1 right and 1 left side sheet, also 12-gauge annealed steel; 1 right and 1 left ledge for contact of pan; 1 drain plug boss, tapped for 1-inch pipe plug; 1 baffle plate; 1 steel casting used as clean-out plate boss.

The redesign accomplished five important cost-saving advantages:

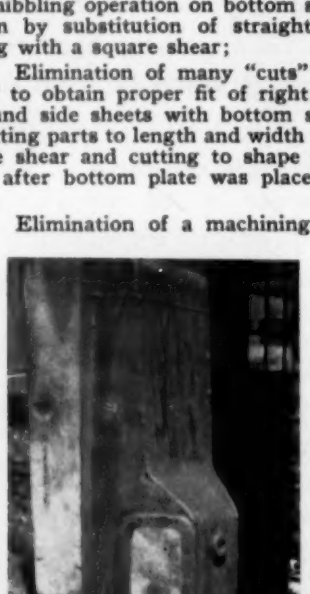
(1) Elimination of a planing operation on front and rear end castings by disc-grinding before assembly;

(2) Elimination of complicated 1½-hour nibbling operation on bottom sheet of pan by substitution of straight-line cutting with a square shear;

(3) Elimination of many "cuts" and "trys" to obtain proper fit of right and left-hand side sheets with bottom sheet by cutting parts to length and width with square shear and cutting to shape with torch after bottom plate was placed in jig;

(4) Elimination of a machining operation, on right- and left-hand ledges, (which act as contact surfaces of pan), by changing stock from 1½ inch to 1¼ inch to which it was formerly machined anyway;

(5) Elimination of final planing operation on gasket surface by use of simple welding jig and careful, systematic welding procedure.



Arc welded steel oil pan built to new design which reduced cost 45%.

Although the redesign of the bottom sheet (in three pieces instead of one) necessitated two additional welds, no difficulty was experienced since all welding was accomplished without removing the pan from the jig. Further advantage was provided by performing all welding in downhand position. By limiting the length of welds to 6 in. stress was distributed throughout the entire pan which prevented localized stress at any point. The accompanying illustration shows the oil pan arc welded to the new design at a 45% saving in cost.

Data and illustration from award study submitted to the James F. Lincoln Arc Welding Foundation by Earle S. Lee, welding foreman, Buda Co., Harvey, Ill.

» «

Welding Metallurgy Encompasses Entire Metallurgical Field

★ The "metallurgy of welding" is not a distinct field, but rather an almost complete summation of all the individual metallurgical processes, said Dr. Gilbert E. Doan, head of the department of metallurgy of Lehigh University, addressing the Notre Dame chapter of American Society for Metals.

First, when the welding rod and base metal are melted, all the phenomena of gas absorption, surface tension, viscosity, and gas escape come into play just as they do in steel foundry practice. The surface tension may be lowered by adding less than 1% antimony to the coating, causing a spreading effect on the liquid metal and speeding up the melting operation.

Second, the atmosphere acts on the superheated, finely divided metal just as it does on the Bessemer converter, burning out carbon and silicon and tending to remain dissolved in the iron. The shielded arc partially prevents these actions.

Third, a cast structure is formed by the freezing of the weld, one with a columnar structure of an ingot, due to the rapid chill, and with piping and segregation.

Fourth, the "casting" fastened to the sides of the "mold" shrinks, setting up high internal stresses and deforming or sometimes cracking the metal.

Fifth, any previous heat treatment or cold working of the base metal is partially or completely destroyed by the heat flowing out of the weld.

Sixth, the rapid cooling of the weld zone by conduction (and radiation) from above the critical temperature results in the decomposition of austenite at subcritical temperatures, involving thus the entire "S-curve" phenomena.

Seventh, the weld, containing oxygen and nitrogen compounds in super-saturated solution, now age hardens, to a lesser degree in coated electrode welds than in bare welds, rising in tensile strength and losing ductility.

Eighth, testing both destructive and non-destructive, is an increasingly important step.

» «

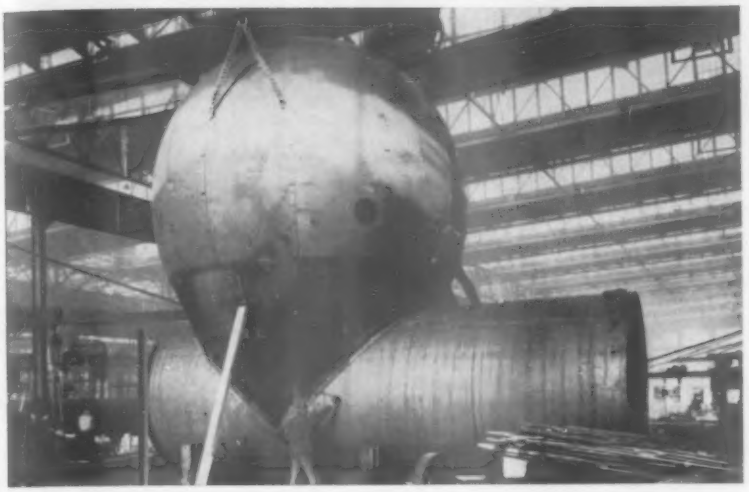
Creep-Resistant Steels

(Continued from Page 15)

Because of the higher strength of the alloy, stress relieving may require a longer period of time. Keeping the temperature nearer to 1200 deg. F. than to 1100 deg. F. will aid in the proper dissipation of internal stresses. Some manufacturers feel that twice the holding time at the elevated stress-relieving temperature improves the product.

Whenever elevated temperature is associated with high-pressure operation, the use of carbon-molybdenum steel is clearly indicated. Combining as it does high creep strength with lower overall cost, this alloy is being put into service in constantly increasing tonnages. Possessing excellent ductility and impact resistance along with good weldability the material may be welded with the utmost confidence.

Brief Sketches of Welding Jobs



This novel appearing structure illustrates how far designers are able to go in arc welding fabrication which involve complex assemblies of curved plates. Photo (Wilson Welder & Metals Co., Inc.).

Pump Chamber Construction Calls for Ingenuity in Design

★ The construction of a welded pump chamber, pump shaft and sump presents a variety of joint types to challenge the ingenuity and workmanship of the plate fabricator. In one instance the fabrication of such a unit involved the mounting of the pump chamber, a 21 ft. diameter sphere, on the pump shaft, a 10 ft. diameter cylinder in such a manner as to place the center of the sphere 12 ft. distant from the center line of the cylinder.

In the construction of the sphere 18 pieces of plate were required. The main section containing 12 orange peel plates; two dished heads were used in the crown section and the transition section was made up of four plates.

The cylinder, 31½ ft. long, was made up of seven plates. Four plates were single rings while three were spit at the intersection of the sphere and cylinder. The sphere and cylinder were completely shop assembled and one end of the cylinder was welded closed at that time. The other end of the cylinder was prepared for field welding. The unit was then disassembled and shipped to its location for field welded erection. All of the field welds were 60° single V butt welds.

The sump, however, was entirely shop welded. It consisted of a 4 ft. long 1½ in. diameter tube with a tangent portion. The sump was mounted with its cylindrical portion projecting 2½ ft. beyond the end of the cylinder on a center line 6½ ft. from the center line of the cylinder. The ends of the pumps were closed with ⅜ in. plate, the same thickness plate that was used throughout the unit.

Youth's Fabric Car Has Welded Body

By O. I. SPRUNGMAN

★ A midget motor car of radical design and construction, created by Nelson Cornelius, Jr., of Minneapolis, Minn., is making its bid for popularity among streamliners. The body of the car consists of a gas-welded steel airplane type framework over which a rubberized covering is held with snap fasteners. The size and shape of steel strip used varies, ranging from ¼-in. round and ½-in. square steel tubing to ⅛ in. x ¼ in. rectangular strip stock.

The auto top is hinged below the front windshield, and may be raised to permit occupants to enter or leave the car. Fenders of the unique door-less car are rattleproof. The motor has pistons and a carburetor of unique design. When necessary the covering may be removed for cleaning or for car repair.

On a recent 4300-mile trip into the Pacific Northwest, Mr. Cornelius averaged 45 miles per hour and found that his total gas consumption was 55 miles per gallon.

Supports Motor Drive

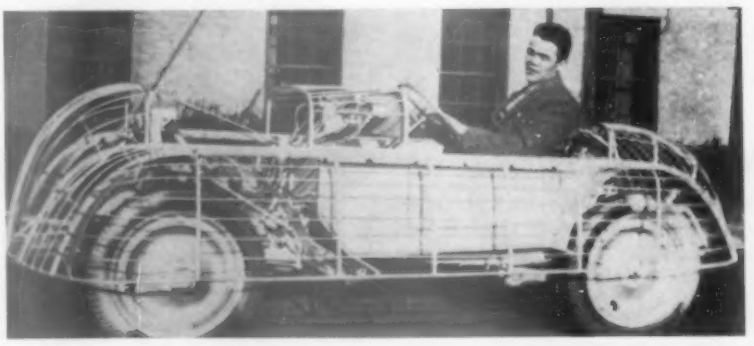
By VIRGIL RAUCH

★ The best way we could find to mount a motor drive on a small milling machine was to bolt a piece of discarded truck frame to the side of the machine. This was strong enough to carry the weight, but was too flexible. To stiffen it, we welded on a piece of plate to make a closed box post. This welded post has been in use for over a year.

Welded box column for supporting motor drive.

» «

The Alexander Milburn Co., 1424 West Baltimore St., Baltimore, Md., announces that it will pay $5,000.00 "for the submittal of a welding torch which is absolutely proof against 'flash back' under the most onerous conditions, claimed to be encountered in certain welding operations." The company announcement further states, "In order to encourage the best development in torch design, if such a torch as the above is submitted, and which in the opinion of a reputable and independent committee is found to possess sufficient novel features to be satisfactorily patentable, in addition to the $5,000 award, patent expenses will be defrayed, and a substantial royalty will be paid to the inventor. All communications will be treated confidentially."

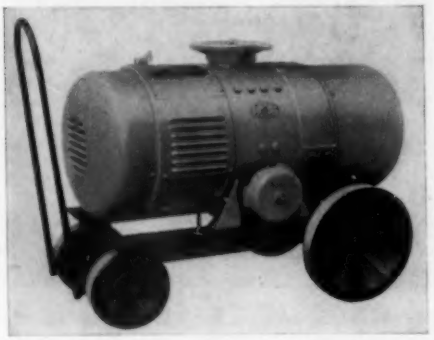


Welded framework of midget car. A rubberized covering is employed over this frame.

New Product Developments

Wilson Announces Dual-Voltage Switch for Arc Welders

★ The **Wilson Welder & Metals Co., Inc.,** has just announced a new dual-voltage switch for installation on arc welding machines, such as the Wilson "Hornet," when they must be used on either of 2 line voltages at different times. The new device, known as the Type CH dual-voltage switch, can be used on any motor employing A.C. current, provided the motor and starter are reconnectable for two voltages.



Wilson "Hornet" arc welder equipped with Type CH dual-voltage switch.

Normally, adjusting a motor so that it will operate at a different line voltage requires changing the heater elements, disconnecting and reconnecting the motor and magnet coil leads. This operation takes anywhere from ½ to 2 hrs., however, with the switch installed the change can be made in less than a minute. Raised figures on the switch base indicate the line voltage for which the switch is set.

The standard dual-voltage switch is designed for 220-440 volts of a delta connected motor—the type used on Wilson Welders. It reconnects the stator winding and also adjusts the holding coil of the magnetic starter and heater relays. Other connections, such as 220-440 volts of Y connected motor and of Y delta connection (380/220) are all readily obtainable.

Further information on the new Type CH dual-voltage switch can be obtained by writing the **Wilson Welder & Metals Co., Inc.,** 60 East 42nd St., New York, N. Y.

» «

Two New Welding Gloves

★ Two new welding gloves have been announced by the **American Optical Co.,** Southbridge, Mass. The TX100 glove is a streamlined welding glove that presents an entirely new idea of comfort, quality, workmanship and wear. Made from a very good grade of chrome tan horsehide and from a "gun-cut" pattern, no seams at all are exposed to active wear. All are at the back of the fingers, except at the base of the second and third fingers, and these seams are welt reinforced. The thumb and index finger are also reinforced. This reinforcement is one-piece, continuous from tip of index finger to tip of thumb. The back of the glove is one-piece, removing any chance of seam breakage under extreme heat. The inside is insulated with wool. This new glove is made in a regular size that measures 14 in. overall, 5 in. across palm with a 6 in. gauntlet.

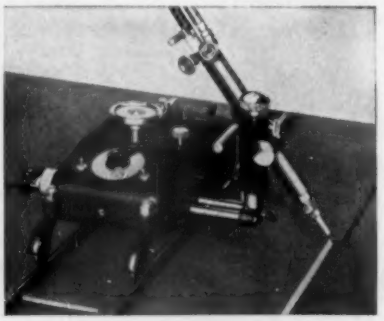
The other new glove, of slightly different design, is made on the "gun-cut" pattern from carefully selected chrome tanned horsehide, with a seamless palm. All seams of the 3015 glove are at the back of the fingers (where they are not exposed to wear) except for welt-reinforced seams at bases of second and third fingers. Differences in design from the No. TX100 glove are these: Thumb and index fingers are reinforced. The back of the glove is reinforced with an outside patch—not one-piece construction.

» «

Harris Portable Cutting Machine

★ **The Harris Calorific Co.,** Cleveland, Ohio, announce the new and improved Model "K" portable, motor-driven gas cutting machine. This is an efficient unit for cutting steel of light or heavy section. It enables metal working shops and manufacturers to replace castings and forgings with parts quickly flame-cut from inexpensive and readily accessible steel plate. It also enables shops to expand their services and handle work heretofore out of their equipment range.

The Harris Model "K" is powered by a universal electric motor and will cut straight lines of any length, with square or beveled edges; 1 in. to 86 in. diameter circles with standard equipment; possesses an exceptional speed range from 3 in. to 60 in. per min., forward or reverse. An "instant stop" feature (no over-run) permits cutting of sharp angles, and a tracing feature provides for cutting irregular forms. Convenient switch permits the machine to be reversed instantly.



Harris Model "K" portable motor-driven gas cutting machine.

The Model "K" is "streamlined," with low chassis and underslung torch holder, eliminating harmful vibration and assuring exceptionally true cuts. A mounting for 2 torches is provided. The smart appearance of the Model "K" is achieved by the combination of durable black crackle finish and chromium trim. It weighs 45 lbs. complete with torch. Maximum traction is assured through means of two large diameter hardened drive wheels. Swivel follower wheels provide 4-point support. One point oiling feeder line to all bearings provides lubrication constantly.

Many different Harris torches are available for this machine, all of them making efficient use of either acetylene, propane, natural gas or other fuel gases in combination with oxygen. Standard equipment includes cutting torch and tip, universal torch mounting, circular cutting attachment, 5-ft. track, and electric socket plug. Special attachments are available for a wide variety of unusual applications. Illustrated Folder (W-62) will be sent to the reader upon request.

» «

Marquette Portable Acetylene Generators

★ The **Marquette Manufacturing Company** of Minneapolis, Minn., announce the marketing of four new portable acetylene generators. Ranging in carbide capacity from 12 to 50 lbs., these four models offer a size and a price to fit the needs of all welding shops. The economies derived from these models are said to be substantial. The new Marquettes will deliver pure gas at a cost claimed not to exceed 1¼ cents per cu. ft.

In addition to the savings and purity of gas, the new Marquettes are small in size and easily moved about. With generated acetylene shop space because it frees shops for storing empty cylinders eliminated, and the user is assured of a plentiful supply of gas at any time. All models except the smallest (No. 512) are listed by Underwriters' Laboratories Reexamination Service.

Model 512 is simple to operate. Filling is accomplished easily by loosening four wing nuts, lifting the hopper from the generator and placing it bottom side up on the floor. Carbide can then easily be added through the opening provided for this purpose. Twelve gallons (1 gallon to every lb. of carbide) of water are placed in the main tank. (After first filling sludge should be drained through tap provided for that purpose.) The hopper can then be replaced and tightened down and the generator is ready

A Faunce holder in position for welding two 3 in. x 3 in. x ⅜ in. angle using ¼ in. electrode.

Faunce Automatic Electrode Holder

★Manufacturing and sales rights on the Faunce holder for electrode holders have been obtained by the Lorain Division of the **Carnegie-Illinois Steel Corp.**, Johnstown, Pa. The Faunce holder has been designed to hold an electrode holder in such a manner as to permit the making of most straight line welds automatically, the weld bead progressing as the electrode melts. By this automatic operation, one operator is said to be able to take care of several welding operations at one time.

The holder will take ⅛ to ⅜ in. coated electrodes, using either AC or DC welding current and can be adjusted to regulate length and size of bead up to certain limits. The penetration and appearance of the weld are claimed to be the same as that of a good downhand weld. It is stated that the simplicity and low cost of this device make it desirable for many shops engaged in production work.

» «

Improved Monelite Goggle

★Retaining former advantages and incorporating three new features, the new Monelite Goggle, manufactured by the **Dockson Corp.**, Detroit, Mich., provides greater comfort, decreased weight, and easier adjustment through a broader facial contact, a new nose bridge adjustment, and the new Dowmetal bezel.

New Monelite goggle provides greater comfort to the wearer.

The new Monelite Goggle is of lighter weight due to the Dowmetal bezel. Dowmetal, 36% lighter than aluminum, eliminates extra weight in thin section construction without sacrificing strength or durability. This bezel provides greater range of vision and is easily removed from the goggle cup.

Quick and easy adjustment to various head sizes is possible with the new nose bridge adjustment. The new broader facial contact, with anatomically correct right and left eye cups give a comfortable and snug fit to the face without irritation to the wearer.

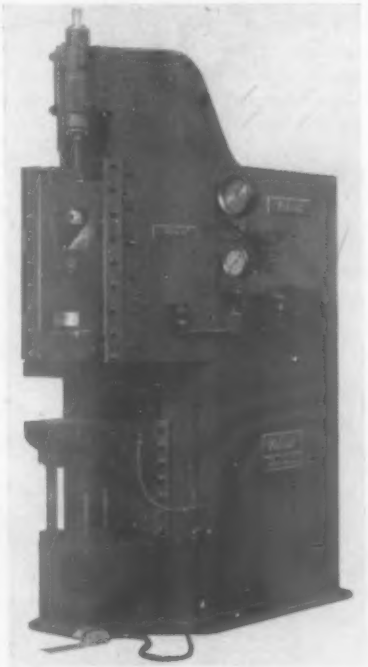
The Monelite Goggle has a still greater range of utility and safety when Bafl-Vents and rubber face pads are used. Bafl-Vents are easily inserted in the goggle cups. They provide protection for the sides of the goggle from dust, splashing acid, light rays, etc., and still allow the Monelite cooling cross ventilation. Where there is intense heat and a cushion is needed between face and goggle, the rubber face pads can be readily snapped on the Monelite Goggle.

A complete selection of 50mm. shatterproof, industrial, hardened, and welding lenses is available.

» «

Heavy-Duty Projection Welder

★The **Federal Machine and Welder Co.**, Warren, Ohio, announce the P-4 Type heavy-duty projection welder, which may be furnished for hydraulic operation, air operation or motor operation.



Federal heavy-duty projector welder.

There is illustrated a direct hydraulically operated machine, which has a two-pressure pump, giving very high-speed operation while using a comparatively small motor to drive the pump, since only low pressure is used for bringing the slide down until the electrodes contact the work. Then, the machine is automatically thrown over on to high pressure to actually perform the welding operation and when the welding cycle is completed, the head is returned by low pressure supply, giving high-speed operation with a small amount of motor power.

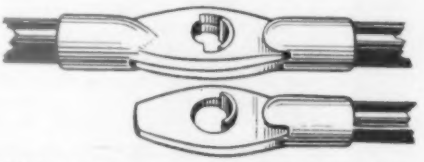
This machine is offered in five transformer capacities, ranging from 250 to 600 kva. inclusive. A four-point regulator switch is mounted on the side of the welder, convenient to the operator, which gives a total of eight steps of heat regulation through a high and low plus four-point tap arrangement.

The stroke of the welding slide is adjustable from 1 to 4 in. and the lower combination knee and platen has an eight-inch vertical adjustment by means of three jack screws, which insures perfect alignment at all times. This means that almost any height of die may be set in this machine on account of the adjustment provided in the welding slide, also the knee.

» «

Major Cable Connector

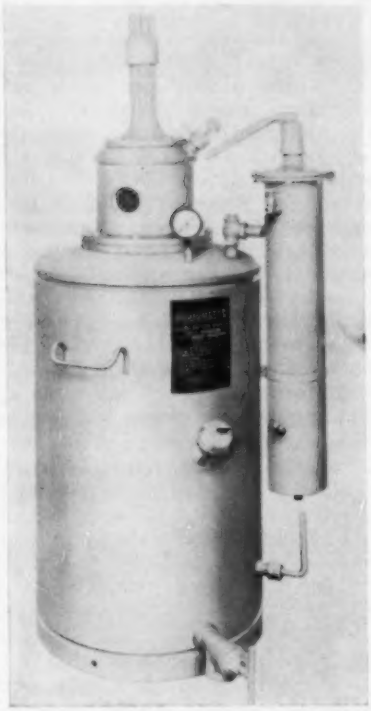
★A new type of cable connector designed especially for use with welding cables is announced by **Major Engineering Works**, 312 Second St., Des Moines, Iowa. As shown in the sketch, both ends of the connector are alike, which simplifies the task of making a connection. Any two cable ends may be linked



Major cable connector requires no bolts.

quickly to give a good electrical connection. The connection can be just as quickly broken when desired. No bolts are required. These cable connectors are available in one size only, which will accommodate cable sizes from No. 2 to No. 00.

Now Is the Time to Join the
AMERICAN WELDING SOCIETY
•
33 West 39th St. New York City



Marquette portable acetylene generator.

for service. Charging is begun by merely lifting the hand wheel at the top of hopper. Charging rate can be adjusted by turning the hand wheel right or left depending on pressure desired. The generator is entirely automatic thereafter.

Operation of a Marquette Generator is fully automatic once the release cap at the top of the generator is given a simple twist to begin the operation. No attention or watching of the gauge is required on the part of the operator. All three models will supply sufficient gas for any type or make of oxy-acetylene welding or cutting torch.

A small observation window permits the operator to observe the quantity of carbide remaining in the hopper so that there need be no danger of running out of gas in the middle of a welding operation.

Gas pressure can be easily and accurately regulated or set for a predetermined pressure by the small adjustment screw at the top of the hopper. The pressure regulating spring is of the extension type rather than the usual compression type, furnishing greater sensitivity and more uniform pressure control.

From the standpoint of safety the Marquette generators are constructed under the latest and most exact insurance company standards. They are equipped with an interlocking safety bar to insure that no pressure exists in the generator before removing the carbide filler cap. A water seal tank on side of generator washes the acetylene and acts as a hydraulic safety valve in case of back fire. It is further protected with a flash back valve and blow-off valve.

Marquette portable acetylene generator No. 512 has a 12-lb. carbide capacity, 12 gal. water capacity, stands 40 in. high, weighs 95 lbs. and produces 24 cu. ft. per hr.

Number 515 holds 15 lbs. of carbide, 17 gal. of water, is 50 in. high, weighs 96 lbs. and delivers a maximum of 30 cu. ft. per hr.

Number 530 has a capacity of 30 lbs. of carbide and 33 gal. gal. of water, is 61 in. high, weighs 123 lbs. and produces 60 cu. ft. per hr.

Number 550 is the largest size, holding 50 lbs. of carbide, 55 gal. of water, stands 69 in. high, weighs 177 lbs. and delivers up to 100 cu. ft. of acetylene gas an hr.

» «

Twin-Stage Regulator

★ The **Alexander Milburn Co.** announces their new Type FF "Twin-Stage" regulator. It is another member of the Milburn ball seat group.

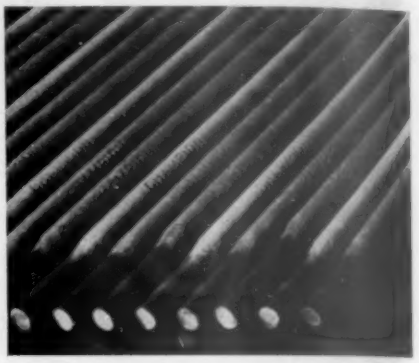
Unlike the average methods, the first stage of the Type FF can be adjusted to various pressures, thus permitting it to be used for different operations. After the selected pressure is set, the delivery stage may be adjusted to any desired working pressure up to 200 lbs., or more, if specified. It operates smoothly, and permits a uniform delivery.

The outstanding features of the Type FF's simplified construction is a unitary valve assembly, which is used in both stages. This assembly has only four parts—a small body, stainless steel spring, stainless steel ball, and special vulcanite seat—operated by a monel metal pin. Seating is with instead of against the pressure. Each stage has a loose, replaceable diaphragm, and removable and interchangeable inlets, adaptable to any tank or line connection for any type of gas. Non-corrosive cylindrical filter screens enclose seat units, thus insuring protection from dirt and foreign particles. The bodies and adjusting keys are of forged bronze.

Particularly interesting is the fact that the first stage of the Type FF can be purchased separately, and attached to practically any make of single stage regulator, converting it to two-stage control. Only simple adjustments are necessary.

For complete information about the Type FF "Twin-Stage" Regulator, write to the **Alexander Milburn Co.**, 1493 West Baltimore St., Baltimore, Md.

» «

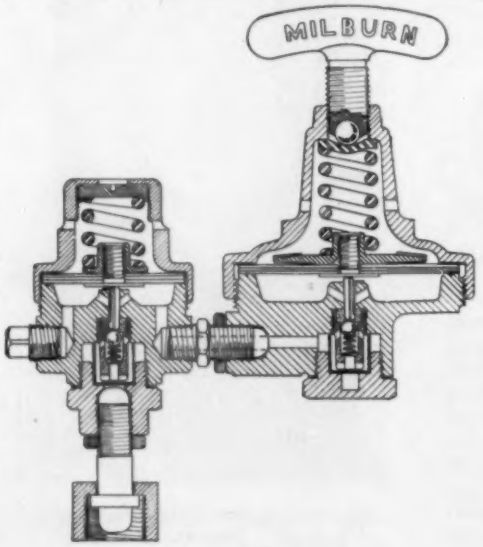


Champion trade name is imprinted on flux coating of electrode.

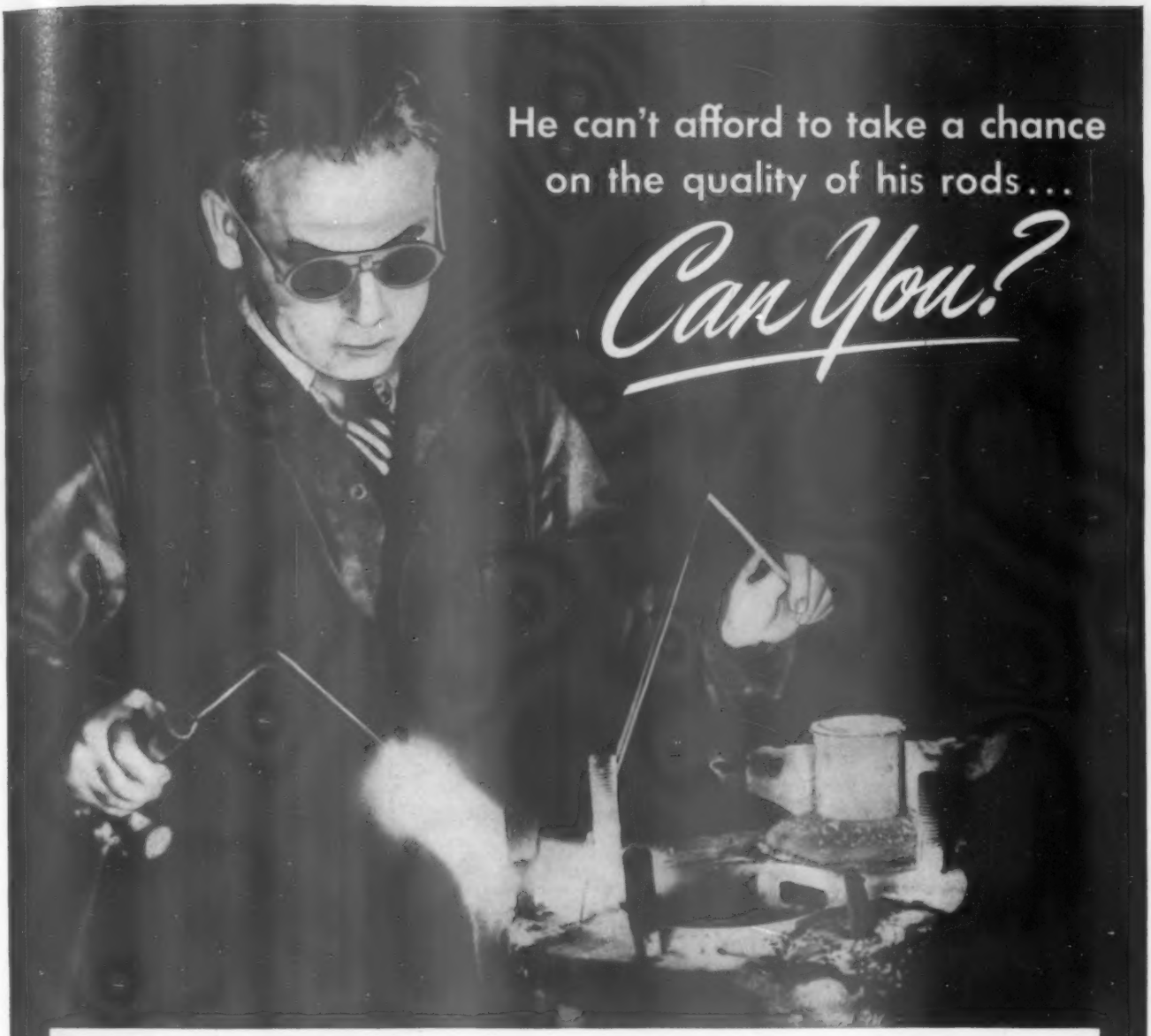
Champion Electrodes Have Trade Name Imprinted

★ What is reported to be a new idea in the merchandising of electrodes, has recently been announced by The **Champion Rivet Co.**, Cleveland, Ohio. As shown in the illustration, Champion electrodes are now imprinted with "Champion" trade name in the flux coating.

It is practically impossible for a welder to distinguish one make of electrode from another. Some manufacturers have attempted to distinguish their respective types of electrodes by various color combinations, and other identifying marks, but this is said to be the first time that the name of the manufacturer has been imprinted into the flux coating. This idea may be carried further to the extent of marking on the electrode the type of polarity to be used, and also to indicate the type of alloy the electrode contains.



Milburn Type FF "Twin-Stage" regulator features a unitary valve assembly in both stages.



EVERY metallurgical precaution is taken to assure the uniform composition and unvarying high quality of Anaconda Welding Rods.

Thousands of foremen, welders and helpers prefer them to all other brands. They help good workmen do good work.

There are eighteen different Anaconda Welding Rods... a suitable one for every gas or electric bronze-welding purpose. Available through leading distributors. Usually shipped in bulk, but also obtainable in clearly labeled 10-lb. packages. Our new publication B-13, mailed on request. 40121

. . .

Visit the Copper & Brass Industry Exhibit in the Hall of Industry, New York World's Fair, 1940

N.Y.W.F.

ANACONDA
from mine to consumer

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Company

News of the Industry

Civil Service Examinations—Inspectors of Ship Construction and Materials

The United States Civil Service Commission has announced open competitive examinations to fill inspector positions in the Navy Department for duty in the field wherever assigned. The examinations cover the following positions: Inspector, ship construction, also senior inspector, $2,000 and $2,600 a year respectively, with the following optional branches—hulls, mechanical, electrical; inspector, engineering materials, also senior inspector, $2,000 and $2,600 a year respectively, with the following optional branches—hulls, mechanical, electrical, and radio; junior inspector, engineering materials, $1,620 a year. The salaries are subject to a retirement deduction of 3½ percent.

Applicants must have had inspectional experience appropriate for the grade and optional branch. For the junior grade, applicants must not have passed their thirty-fifth birthday; for the other positions they must not have passed their fifty-fifth birthday.

Applications will be rated as received at the Commission's Washington office until further notice. Qualified persons are urged to apply at once.

Further information regarding the examinations, and the detailed requirements, are given in the formal announcement. Announcements and application forms may be obtained from the Secretary of the Board of U. S. Civil Service

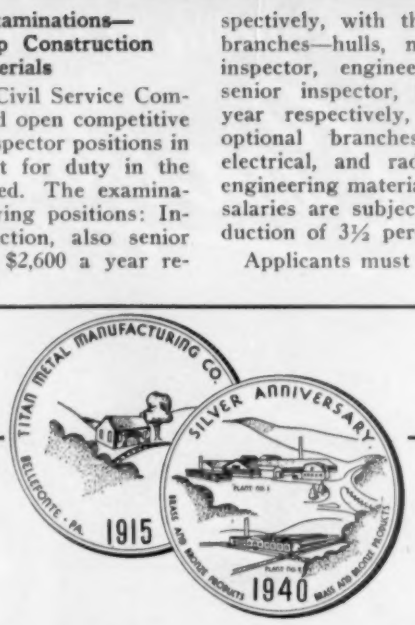
Instruments For Checking

(Continued from Page 31)

abnormal manner, the green light is extinguished and instantly the red light comes on. This has been found particularly valuable in training operators, but its main purpose is for making precision measurements for studies of welding operation involving large numbers of pieces, where an error in setting a rate, or lack of information as to the easiest way of doing the job, might result in a very large increase in labor cost.

These instruments have been developed over a period of years (Pat. 2027224) and field tested for a wide variety of conditions. In principle, the instruments utilize vacuum tubes to pick up oscillations of voltage arising from the transfer of metal across the arc from an electrode. These oscillations are filtered out from other extraneous oscillations which occur in an arc welding circuit and then amplified to operate relays which in turn operate the indicating or recording devices. The instruments shown in Fig. 2 and Fig. 3 are provided with receptacle for attachment to curve drawing instruments of the usual kind in addition to the self contained clocks.

It may be properly said that the instruments are merely tools to be used in the study of operator behavior. The instruments merely record how the operator behaves. The study is then based upon the recordings of the instruments.



Features which assure SUPERIOR WELDING QUALITIES of

TITAN BRONZE WELDING ALLOYS

Use of Purest Raw Materials Obtainable, such as Electrolytic Copper 99.96 in purity and Electrolytic Zinc 99.99 plus.

Strict Laboratory Control; Uniformity of Mixtures and Casting Temperature.

Double-Deoxidation Process which eliminates injurious gases.

Penn Bronze—is a general purpose rod. It is low melting (1620° F.) and tins easily and uniformly on galvanized, malleable or wrought iron as well as steel, brass, bronze and any other non-leaded metal with a melting point above 1850° F. It makes tough high-strength welds of high ductility, immune to strain hardening and with great abrasion and corrosion resistance.

Titan Manganese Bronze—is used where both hard and tough welds are desired. Although this is a general purpose rod, it is especially recommended for cast iron. It is free flowing and gives extremely dense, non-porous welds.

Titan Bronze—is a tin bronze with uses and characteristics similar to the manganese alloy; penetrates seams and crevices readily.

Submit your particular bronze-welding problem for solution by our engineers. Recommendations gladly forwarded, together with generous sample for trial in your own plant.

TITAN METAL MANUFACTURING CO.

Bellefonte, Pennsylvania

Now Is The Time To Join

AMERICAN WELDING SOCIETY

Examiners at any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

» «

7th Annual Metal Mining Convention and Exposition of the American Mining Congress will be held at the Broadmoor Hotel at Colorado Springs during the week of September 16. Over 75 exhibitors are planning displays of machinery and supplies designed to reduce costs and increase safety in metal mine and mill operations. The exposition will include displays of machines which have made possible the profitable working of low grade ores and which will greatly aid in the production of those metals so vital to national defense.

» «

Steel Industry Appoints Special Committee on Government Specifications—The Board of Directors of **American Iron and Steel Institute** has appointed a Special Committee on Government Specifications to cooperate with governmental departments and agencies in formulating and interpreting specifications for steel products.

Chairman of the committee is **E. C. Smith,** chief metallurgist, **Republic Steel Corp.,** Cleveland, O. Other members of the committee are **V. H. Lawrence,** assistant to vice-president, **Alan Wood Steel Co.,** Conshohocken, Pa.; **P. E. McKinney,** metallurgical engineer, **Bethlehem Steel Co.,** Bethlehem, Pa.; **J. S. Richards,** manager, metallurgical department, **American Steel and Wire Co.,** Cleveland, O.; and **E. C. Wright,** chief metallurgist, **National Tube Co.,** Pittsburgh, Pa.

The committee was appointed for the purpose of furnishing information which will enable government officials to align their specifications more closely with commercial specifications in order to expedite production of steel for the National Defense Program. Many of the existing government specifications have not been brought up to date to include the best practice of the industry.

Inquiries relative to the technical aspects of government specifications for steel may be addressed to the chairman of the committee or to **American Iron and Steel Institute,** 350 Fifth Ave., New York, N. Y.

» «

Welding Speeds Production For National Defense

Production for National Defense could be speeded up immensely and the five to seven-year period estimated time for completing the Defense Program could be greatly shortened by full utilization of welding, according to figures released by **The James F. Lincoln Arc Welding Foundation,** Cleveland, Ohio.

Battleships, destroyers, submarines, aircraft, tanks, gun mounts, scout cars, tractors, trucks, railway artillery, as well as industrial equipment for armament production, could be produced in 30% less time than required for conventional methods and at approximately similar cost savings, it is claimed. The Foundation bases this estimate upon reports in its files covering the application of arc welding to virtually every type of industrial product and structure. These

A SUMMARY OF EASY-FLO ADVANTAGES

Brazes ferrous, non-ferrous and dissimilar metals.

Makes joints that are gas-tight and equal to the parent metals in strength, ductility and resists corrosion.

Makes neat joints that need little or no cleaning or finishing.

Saves brazing time, material and gases because of extreme fluidity and low working temperatures — also protects physical properties of metals.

●

For best results always use the low temperature HANDY FLUX.

THIS assembly, shown actual size, is used inside the sealed compressor of domestic refrigerators made by Sunbeam Electric Mfg. Co. It serves as a gas passage from compressor to pump. This means that the two joints must be *absolutely gas-tight* and *absolutely dependable in service.*

Easy-Flo brazing consistently meets these exacting requirements and at low cost. One ounce of Easy-Flo brazing alloy makes 150 joints and because of its low melting point (1175 Deg. F.) and quick flowing qualities, it works fast with a considerable saving in labor and gas. Both joints, one copper to steel and the other copper to brass, are made at one time with the same alloy.

This typical job makes it easy to understand why the use of Easy-Flo brazing is spreading so widely throughout industry today. Try Easy-Flo brazing on one job in your plant and see for yourself why it improves joint quality, speeds up production and cuts costs. Write today for Bulletin WE-109.

HANDY AND HARMAN

HANDY & HARMAN FOUNDED 1867 QUALITY SERVICE

82 Fulton St., New York, N. Y.

Agents in Principal Cities

In Canada: HANDY & HARMAN of Canada, Ltd., Toronto

studies were prepared by engineers, designers, architects and production officials representing leadership in their respective fields.

The Foundation has compiled statistics which show not only the savings in production time, cost and weight, but also operating advantages made possible through the greater strength and rigidity of arc welded construction. Items covered include both equipment of a military nature and industrial machinery vital in armament production.

These statistics on welding call to mind a recent statement on welded armor plate by **William S. Knudsen**, in charge of production for National Defense.

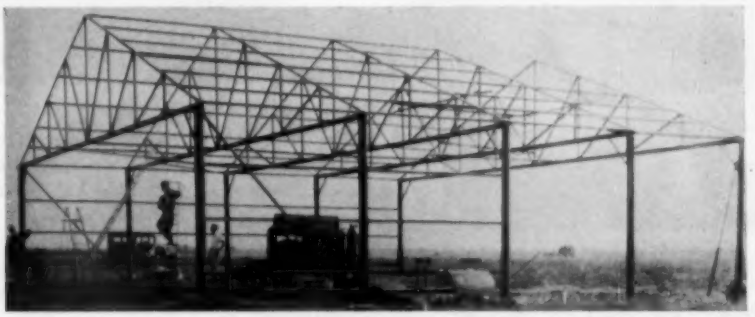
"They told me," said Mr. Knudsen, "you can't weld armor plate. When I first came to Washington they told me they're making bigger bullets now, so we've got to make the armor plate on the outside of our tanks thicker so the boys inside won't get killed. But then they go and put rivets in the armor plate and the only thing the big bullets have to do is hit the rivets and the boys inside get killed anyway."

"So I said, 'Why don't you weld it together instead of putting rivets in it?' They told me you can't weld armor plate. So I said, 'You get me two pieces of armor plate and we'll see if it can't be welded.'"

"I took the two pieces out to a welder I know in Detroit and I said, 'Here are two pieces of armor plate that I want you to weld for me. Use so much of this and so much of that and put them together.'"

"'There it is,' said the welder after he had successfully accomplished the task of welding armor plate. And they told me you can't make it!"

To stop a leak in an 8-in. oil pipe-line operating at a pressure of 800 psi. requires ingenuity. This welding operator, equipped with a 300 amp. gasoline-engine-driven G-E welder, with W-20 electrodes, did the job. A collar of steel was wrapped around pipe at a point a little beyond the leak and ends of collar were butt welded together. Next, collar was slipped along pipe until it covered the leak. Photo. (General Electric Co.)



An economical way to fabricate a small industrial building. Built by welding together sections of discarded boiler tubes.

The Foundation is sponsoring a 2½-year program of industrial study, the object of which is to extend the useful application of welding to the products and works of industry. Awards totaling 446, ranging from $13,700 to $100, and totaling $200,000, will be made after June 1st, 1942, the end of the Program. Particulars relating to the present Program of study may be obtained by writing **The James F. Lincoln Arc Welding Foundation** at Cleveland, Ohio.

» «

The Stevens Hotel, Chicago, will be the hosts of the **29th National Safety Congress and Exposition** from October 7 to 11. There will be many papers and group discussions of interest to the welding, steel and allied industries as well as exhibits of safety equipment of equal interest to these industries.

On Tuesday morning, October 8, there will be a special session for the purpose of bring up-to-date the Safe Practices Pamphlet of the **National Safety Council.** The first pamphlet to be discussed will be on **Gas and Electric Welding.**

» «

The **Association of Iron and Steel Engineers** will hold their **36th Annual Convention and Exposition** at the Stevens Hotel, Chicago, September 25-27. In addition to many papers of interest to the engineers of the iron and steel industries, there will also be an exhibit of equipment used in the industry.

» «

The **National Tractor Meeting** of the **Society of Automotive Engineers** will be held at the Schroeder Hotel, Milwaukee, Wis., September 24-25.

» «

The **Annual Meeting** of the **Gray Iron Founders' Society** will be held September 12 ot the Hotel Cleveland, Cleveland.

REGISTERED U. S. MANGANAL PATENT OFFICE

SAVE . . . by welding

MANGANESE STEEL

Jaw Plates, Gyratory and Roll Crushers, Shovel Teeth, Hammers, Tractor Tread Grousers, etc., with

Manganal 11 to 13½% Manganese Nickel Steel

U. S. Patents 1,876,738, 1,947,167 and 2,021,945

WELDING ELECTRODES

WEDGE and APPLICATOR BARS

Hot Rolled PLATES

Write for name of nearest distributor

STULZ-SICKLES CO. Sole Producers **91 N. J. Railroad Avenue, NEWARK, N. J.**

If not acquainted with SEACO HARD-SURFACING WELDING ELECTRODES, write today for descriptive circular.

A.W.S. Activities

The **Cleveland Section** A.W.S. schedules eight meetings for the 1940-41 season. All six regular sessions will be dinner meetings at the Mid Day Club atop the Union Commerce Building.

October 9, 1940—"Welding in National Defense." **J. F. Jenks, Col.,** Ordnance Dept. U. S. Army.

November 13, 1940—"Resistance Welding." **John J. MacKinney,** Welding Engineer, **E. G. Budd Mfg. Co.,** Philadelphia, Pa.

December 11, 1940—"Welding in the Shipbuilding Industry." **David Arnott,** V.P. and Chief Surveyor, **American Bureau of Shipping,** New York, N. Y.

January 1941—A Fun Social, meeting date and details later.

February 12, 1941—"Welding of Stainless & Alloy Steels." **E. C. Esgar,** Sales Engineer, **Carnegie Steel Corp.**

March 12, 1941—"Welding in the Building Industry." **J. H. Frankland,** Chief Engineer, **American Institute of Steel Construction, Inc.**

April 9, 1941—Forum—this will be sort of an "Information Please" question and answer meeting and we will select a number of recognized experts to answer questions from the floor. Details later.

March 9, 1941—Annual Symposium — Statler Hotel — three or four speakers and a dinner. Details later.

Personals

Carnegie-Illinois Steel Corp. announced today the following personnel changes at its South works. These appointments were effective August 1, 1940.

Carl H. Youngdahl has been appointed assistant superintendent of the power production division after serving as division engineer in charge of operation, maintenance and construction since 1928.

Charles L. Clarke was made superintendent of yards and transportation. He has been employed at South works since 1896 when he began as a switchman. He was assistant superintendent of yards and transportation at the time of his appointment.

Russell W. Davy received the post of construction engineer after serving in various capacities in the Civil Engineering department. During a lapse in service between 1931 and 1937, Mr. Davy was superintendent of engineering at the Chicago Century of Progress and construction engineer for Wilson & Company.

Howard C. Brown became assistant superintendent of yards and transportation succeeding Mr. Clarke. He was assistant to the superintendent of this department in charge of personnel until the present time.

Elwood G. Stewart, who has been Acting Traffic Manager of **Lukens Steel Co.,** Coatesville, Pa., since November, 1939, has been appointed Traffic Manager of the concern. Mr. Stewart was born in New York, N. Y., in April, 1907, and was educated in the public schools of Atlantic City and Camden, N. J. In 1923, Mr. Stewart joined the Accounting Department of the Pennsylvania Railroad where he continued until June, 1931, when he entered the Traffic Department of Lukens. He was promoted to Assistant Traffic Manager in May, 1935.

» «

Dr. J. C. Hodge Joins Wellman Engineering Co.

Announcement is made of the election of **James Campbell Hodge** as Vice-President and Director of the **Wellman Engineering Co.,** Cleveland, Ohio.

Dr. Hodge received his B.S. degree from Case School of Applied Science in 1923, majoring in metallurgy. For four years afterwards he was associated with Bennett and Christensen, consulting chemists and metallurgists serving foundries in Ohio and Indiana.

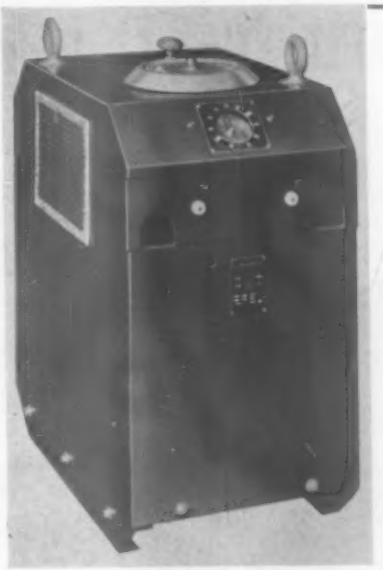
He joined the Babcock & Wilcox Company in Barberton, Ohio, in 1927, as a metallurgist, where he developed and perfected the process of welding used by Babcock & Wilcox Company in the welding of boiler drums and other important constructions, such as the power penstocks for Hoover Dam. He was closely associated with discussions which led to the adoption of fusion welded boiler drums by the U. S. Navy in 1930 and to formulation of welding rules by the Boiler Code committee of the American Society of Mechanical Engineers in 1931. In 1932 he was appointed Chief Metallurgist of the Babcock & Wilcox Co.

Dr. J. C. Hodge

He continued his metallurgical studies at Harvard University between 1931 and 1933. His doctorate was obtained there under the late Professor Albert Sauveur. Since then he has been closely associated with the development of low alloy constructional steels and of the various heat resistant and corrosion resistant steels, particularly with relation to their weldability.

Dr. Hodge is widely known in industry. He has served on technical committees of the American Society for Testing Materials, on the Boiler Code Committee of the American Society of Mechanical Engineers, the Welding Research Committee of the Engineering Foundation, the American Welding Society and the American Petroleum Institute.

He was joint recipient of the J. F.



See your jobber today — or write direct for free literature.

PAY your way to better welding — put G-R on your job!

You can cut your power bills 50% and more by replacing motor-generator equipment with job-engineered, job-tested G-R welders. You'll get **performance** that cuts costs, too: — a smooth, quick-starting arc that puts metal where and how you want; full-range stepless control that gives you **exactly** the heat you want; a stable, easily-handled arc that eliminates magnetic blow, welds faster with less spatter loss and makes the hard, off-position welds easy.

There's a size to fit **your** job — G-R models range from the 15-125 ampere Model 15 to the 90-1250 amperes for UNIONMELT and automatic head welding.

GLENN-ROBERTS COMPANY INC.

1009 FRUITVALE AVE. OAKLAND, CALIFORNIA

Lincoln Gold Medal Award of the American Welding Society in 1938 for the best paper representing original contribution to the advancement of the use of welding.

Trade News

Grinding a welded seam in an 18-8 analysis stainless steel syrup tank (300 gal. capacity).

July Structural Steel Contracts Continue Upward Trend

New orders for fabricated structural steel booked during July were the largest for any month during the past three years, according to reports received by the **American Institute of Steel Construction.** The industry booked a total of 184,499 tons that month, as compared with 114,056 for the same month last year and 109,744 tons for June this year. The increased tonnage booked in July brought the new business during the first seven months of this year to a total of 803,730 tons, which slightly tops the record of last year and compares with an average annual record of 797,906 during the period 1935-1939 inclusive.

The shipments in July totaled 117,438, which is about the average for the past four months. The backlog has now reached the total of 457,401 tons.

» «

Westinghouse Orders Highest in History—Orders booked by **Westinghouse Electric & Manufacturing Co.** for the twelve months ending June 30, 1940, were the highest for any twelve months in the history of the company. For the twelve months orders were $245,256,874 compared with $177,487,833 for the same period a year ago, an increase of 38%. Orders booked for the first six months of 1940 were $135,556,697, compared with $104,538,863 for the same period of 1939, an increase of 30%. Net income for the twelve month period reached the total of $17,352,590, compared with $10,890,958 for the period ended June 30, 1939—an increase of 59%.

Unfilled orders for June 30 amounted to $86,386,749, the highest backlog of orders for regular lines of equipment since Westinghouse **Electric & Manufacturing Co.** was founded. This figure has been exceeded only by a wartime backlog including munitions in 1918. Sales billed for the first six months of 1940 were $115,488,876 compared with $87,716,903 for the same period in 1939, an increase of 32%. Billings for the twelve months were $202,843,336 compared with $162,861,365 for the same 1939 period, an increase of 25%.

The increase in business has also resulted in an increase in the number of employees. On June 30, there were 51,256 employes, compared with 42,967 on June 30, 1939. The previous peak for employment was in August, 1937, when 54,941 were on the rolls.

» «

Maryland Oxygen Co. established by **Howard Guthrie** and **H. M. Macauley**—The **Maryland Oxygen Co.,** 1700 S. Newkirk St., Baltimore, has been recently established to engage in the production of oxygen and acetylene for commercial and industrial uses, as well as oxygen for medical purposes. In addition the company handles a complete line of welding and metal cutting torches and associated equipment.

» «

The **Harnischfeger Corp.** of Milwaukee announces that the **Columbia Supply Co.,** 823 Gervais St., Columbia, S. C., has been appointed exclusive agent for P&H welders and electrodes. They will operate under the supervision of the Harnischfeger office in Washington.

The Improved "Round File" Gas Lighter

Most Economical

Unrivalled economy is provided by the many superior, exclusive design and construction features of the Improved "Round File" lighter
An unusually large file area is provided — approximately one square inch. **The file is of superior quality, hardened in our own factory. The spark metal is of large diameter and the patented cartridge holding the metal locks exactly into position**, permitting instant replacement. **The lighters are cadmium plated, rustproof.**

Circular and prices on request.

SAFETY GAS LIGHTER CO. (Est. 1901) LYNN, MASS.

Current Reviews

Lessons in Arc Welding. Published by **Lincoln Electric Co.,** Cleveland, 1940. Simulated leather, 6x9 in., 144 pages. Price 50 cents in U.S.A., 75 cents elsewhere.

This book will be found helpful not only by beginners learning to arc weld but also by experienced welders desiring the comprehensive practical information contained in the volume. Welding officials, such as supervisors, foremen and instructors, and others seeking a ready reference to fundamental information on arc welding will find a guide to its proper application in this series of 51 lessons.

These 51 lessons cover in four principle sections: Welding with Unshielded Arc Electrodes; Welding with Shielded Arc Electrodes; Electrodes for Particular Joints and Metals; Hardfacing. The text explanations are graphically supplemented by over 100 line drawings and photos for ease of understanding. In addition the book features questions on each of the lessons, enabling the student to check his knowledge.

Obituary

Stanley P. Rockwell Passes Away—Death came suddenly on August 11 to Stanley P. Rockwell when his yacht exploded near Hartford, Conn. Mr. Rockwell, 54, was alone on board the boat when a spark, apparently from a generator, ignited gas fumes and caused the explosion. He was vice-president and general manager of Stanley P. Rockwell Co., a consulting and commercial heat treating firm. His most famed pioneering metallurgical achievement, on which he was awarded the Sauveur Medal in 1939 by the American Society for Metals, was the inventon of the Rockwell hardness tester.

A graduate of Yale, he joined New Departure Mfg. Co., was subsequently consulting metallurgist for E. F. Houghton & Co., joining the Ordinance Department during the War and was later was metallurgist for Weeks-Hoffman Co. and Whitney Mfg. Co. In 1923 he established the Rockwell Co.

Recent Patents

Automatic Arc Welder

2,210,645. **Otto Weigner,** Vienna, Austria, assigned to Elin A. G. fur electrische Industrie, Vienna, Austria. Filed Nov. 9, 1937. Issued Aug. 6, 1940. The inventor combines with a welding head, a cutting device for the production of bared places on a coated electrode. The cutting device has cutters which rotate in planes across the longitudinal axis of the electrode so as to obtain bared places of comparatively small longitudinal extension. Moving elements are coupled with the cutter and come into electrical contact with the bared places, thereby obtaining simultaneous feeding of current to the electrode as well as advancing the wire. The cutter may take the form of a milling device.

» «

Welding Electrode

2,209,829. **Thomas J. Rasmussen** and **Joseph H. Humberstone,** Schenectady, N. Y., assigned to General Electric Co., New York. Filed Dec. 28, 1938. Issued July 30, 1940. An arc welding electrode having a flux coating containing a water solution of a soluble silicate of an alkaline metal as one of its principal ingredients in combination with from two to three per cent of finely divided cellulosic material and one to two per cent of dextrine.

» «

Resistance Line Welding Control

2,209,932. **Eberhard Rietsch,** Berlin, Germany, assigned to General Electric Co., New York. Filed Dec. 12, 1938. Issued July 30, 1940. The inventor discloses a resistance line welding apparatus which includes an electrode to which welding current is periodically supplied at predetermined intervals. Predetermined welding pressure is applied between this electrode and the work to be welded. When the pressure is attained the welding current is applied and automatic means maintain relative movement between the electrode and the work to be welded.

» «

Coated Electrode

2,210,777. **Thomas J. Rasmussen** and **Joseph H. Humberstone,** Schenectady, N. Y., assigned to General Electric Co., New York. Filed Dec. 28, 1938. Issued Aug. 6, 1940. A flux is described which is particularly applicable as a heavy coating for electrodes of the shielded arc type. The flux material also improves the moisture resistance of the electrode coating and accelerates the drying of the coating. The flux is made up of liquid sodium silicate as one of its principal ingredients and magnesium carbonate. In addition there may be added asbestos, titanium dioxide, alpha flock, and ferromanganese. The alpha flock is a form of pulverulant cellulose. This flux when applied as a coating to a mild steel electrode is particularly suited for welding mild steel. Ductility of the deposit is unusually good and good resistance to corrosion is reported by the inventors. Electrodes coated with the flux have a fast melting rate and produce dense deposits without slag inclusions or gas pockets. Low spatter loss and a brittle and porous slag is produced. Another feature of this flux is the production of a smooth weld bead.

» «

Electrode Feed Head

2,210,786. **Reinhard Wasmund,** Frankfort-on-the-Oder, Germany, assigned to General Electric Co., New York. Filed Feb. 28, 1939. Issued Aug. 6, 1940. This patent discloses an automatic arc welder in which an electrode is fed and simultaneously coated with a suitable flux. The electrode passes through an extrusion nozzle which contains a welding flux. The rate at which flux is supplied to the nozzle is automatically controlled by the rate at which the electrode is fed through the nozzle.

» «

Thin Metal Welder

2,211,424. **Claude J. Holslag,** South Orange, N. J., assigned to Electric Arc Cutting & Welding Co., Newark, N. J. Filed Feb. 26, 1938. Issued Aug. 13,

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1940. There is shown in this patent the application of a relatively thin dry coating to a welding rod. The coating is entirely consumed in the arc, or at least the unconsumed portions are so light as to float on top of the molten metal. Two chambers are used to coat the rod, the first containing a sticky material such as sodium silicate and the second containing a dry material which adheres to the silicate. Current passed through the chambers dries the sticky material prior to use of the rod at the point of welding.

» «

Volatile Flux

2,211,448. **Thomas H. Vaughn** and **Arthur R. Lytle**, Niagara Falls, N. Y., assigned to Union Carbide and Carbon Research Laboratories, Inc., New York. Filed Aug. 31, 1937. Issued Aug. 13, 1940. A volatile flux is introduced into either a fuel gas or combustion-supporting gas for use in a blowpipe, the amount of flux being regulated by adjusting the partial pressure of the flux vapors in the presence of the welding gases. The flux may be either a pure compound, a mixture of such compounds, or a solution of the same in a volatile liquid such as ethyl alcohol.

» «

Spot Welding Electrode

2,208,977. **Preston M. Hall**, Worcester, Mass. Filed April 26, 1939. Issued July 23, 1940. The welding of non-ferrous metals presents particular problems for which this inventor has devised a new electrode. Such metals differ substantially from iron and steel in having very limited periods of plasticity, if any, and in being weldable only at the time of transition from a very brief plastic state to a substantially liquid state. For successful welding of such metals, it is essential that welding pressure in a carefully determined amount be instantly applied when the metal reaches the weldable condition, as otherwise burns or unsatisfactory welding will result. The improved electrode is so designed as to provide yielding electrode pressure in a readily adjustable and predetermined amount during the preheating and welding operation, which pressure will react on the parts to be welded as soon as welding conditions are reached. The electrode has an inner member to which the welding contact is mounted, and an outer member with a yieldable compression spring between the two members to take up pressure. The pressure of the spring may be adjusted by a suitable tightening nut. The pressure of the electrode on the work cannot exceed the yielding pressure of the spring in the electrode unit.

» «

Welding Wire Feed

2,209,893. **Karl W. Schreeck**, East Cleveland, Ohio, assigned to Una Welding, Inc., East Cleveland, Ohio. Filed July 23, 1938. Issued July 30, 1940. This invention relates to an automatic welding head which feeds welding wire to the work and which simultaneously feeds and forms a flux carrying tape about the welding wire. The flow of current through the welding head is confined to a relatively short distance to eliminate or minimize the production of heat within the casing which contains the tape feeding and wrapping mechanism and to insure maximum current carrying capacity of the welding wire. The tape is made of paper, fabric, or asbestos and may be coated with various fluxes or the like. A long and narrow brush is provided to contact the welding wire through a continuous slit left by the parallel marginal edges of the tape. This differs from other constructions in which the brush contacts the welding wire ahead of the tape wrapping unit. Moving the brush closer to the point of use of the wire minimizes the obstruction to current carrying capacity normally present where the brush contacts the wire far from the work.

» «

Electric Induction Welder

2,209,637. **Frank L. Sessions**, Lakewood, Ohio. Filed July 11, 1929. Issued July 30, 1940. An apparatus for electric induction welding which includes an energized inducing unit supported on one side of the work, and a separate, energized inducing unit supported on the opposite side of the work. The two inducing units are so arranged as to cause their magnetic fields to pass magnetically in series from the first unit through the work to the second unit to cause heating currents to be induced in the work.

» «

Projection Welder

2,210,056. **E. G. Bierderman**, Detroit, Mich., assigned to General Motors Corp., Mich. Filed July 19, 1938. Issued Aug. 6, 1940. The patent describes a machine for punching projections in work, a conveyor for carrying the punched work, and electrode elements for spot welding the projections. The conveyor functions as one electrode pad of considerable contact area to bridge all the punched out points. An electrode pad of substantially the same area moves upon the opposite side of the work and travels a limited distance along with the work carrier while the projection welding is taking place. A fluid operated device presses the pad against the work while the pad travels with the work. A return mechanism brings the pad back to its initial position. The machine is capable of continuous welding by means of the plurality of spot welds at the punched projections.

» «

Protective Arc Chamber

2,210,370. **Juan R. Herradora**, Jersey City, N. J. Filed Aug. 2, 1938. Issued Aug. 6, 1940. The purpose of this cham-

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ber is to completely enclose an electric arc, a suction outlet being employed to draw away the noxious gases and dust of the working space or room. The chamber has a telescopic extension carrying a sliding window of black or colored glass which is opaque to visually harmful radiations from the arc. The chamber has one or more orifices for the insertion of the welding electrode and is fitted with a rotary or swiveling connection for a tube leading to a suction mechanism for ejection of gases, fumes and dust resulting from the welding process. The chamber is made of a heat-resistant and dielectric material, such as Bakelite.

Trade Literature

New Ohmite Catalog and Manual—A new, comprehensive 96-page Industrial Catalog and Engineering Manual has been issued by the **Ohmite Manufacturing Co.**, 4835 Flournoy St., Chicago.

This book is unlike anything else in this field. It's more than a catalog—it is actually an encyclopedia of helpful facts and information on the selection and application of Resistors, Rheostats, Tap Switches, Chokes, and Attenuators.

It contains a wealth of engineering data, handy reference tables, dimension drawings, illustrations, special guide pages, and a manual of resistance measurements—all so clearly defined and arranged as to make it easy to select proper stock units or to plan special made-to-order units for any application.

Catalog 40 is a complete, handy valuable reference for all resistance applications, and should prove extremely helpful to engineers, production managers, and purchasing agents.

Copies of the Ohmite Catalog 40 will be sent to engineers, production managers, purchasing agents or executives who send in their names on company stationery, stating their positions.

» «

Lathe Catalog—The South Bend Lathe Works, South Bend, Ind., has issued a catalog which contains 112 pages with over 250 illustrations and shows 75 different sizes and types of South Bend back-geared screw cutting lathes for production, tool room and general shop work.

» «

The **"Metco News"** is the title of a new publication sponsored by the **Metallizing Engineering Co., Inc.**, 2107—41st Ave., Long Island City, N. Y. This periodical will be devoted entirely to the latest developments and applications of the metal spray process. It will be edited for all those actively engaged in the maintenance, salvaging or manufacture of metal products and equipment. Any readers desiring to receive the **"Metco News"** should write direct to the publisher.

Square Frame Arc Welder—In connection with the appearance on the market of the P&H-Hansen WD-150 square frame arc welder, the Harnischfeger Corp. of Milwaukee, Wis. has just released a descriptive folder on the new machine.

The WD-150, measuring less than 33 in. in length and 1 ft. in height, delivers welding currents ranging from 200 down to 15 amps. Only one indicator setting is needed to obtain any desired current. Details on the welder's square frame design and a description of the multiple welding service obtained from parallel hook-up of two or more machines, are discussed and illustrated with photographs and diagrams. Copies of Bulletin W-28 may be obtained by writing to the Harnischfeger Corp., 4400 W. National Ave., Milwaukee, Wis.

» «

Eye Protection—A new 72-page catalog filled with many ideas for those interested in eye and face protection has been issued by **Sellstrom Mfg. Co.**, 615-649 N. Aberdeen St., Chicago, Ill. Known as Catalog No. 18, it fully illustrates the complete line of Sellstrom eye protection equipment, which includes protective lenses for practically every industrial purpose. Welding goggles and helmets are prominently featured in the new catalog. A variety of general purpose industrial goggles is also shown. Information on industrial respirators for dust hazards and safety gauntlets is also listed in this catalog.

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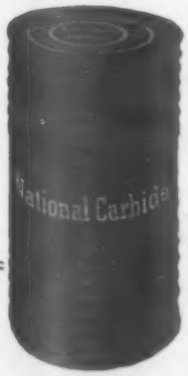

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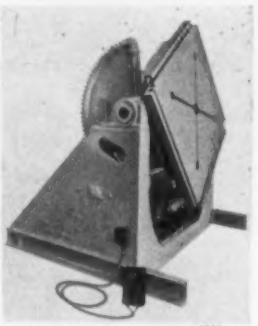

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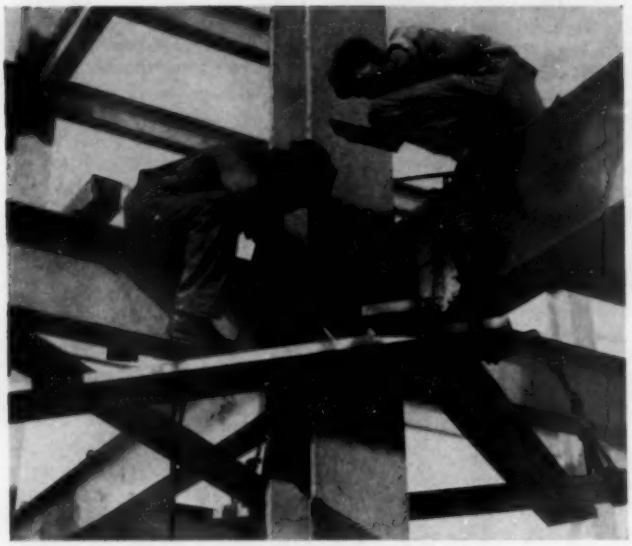
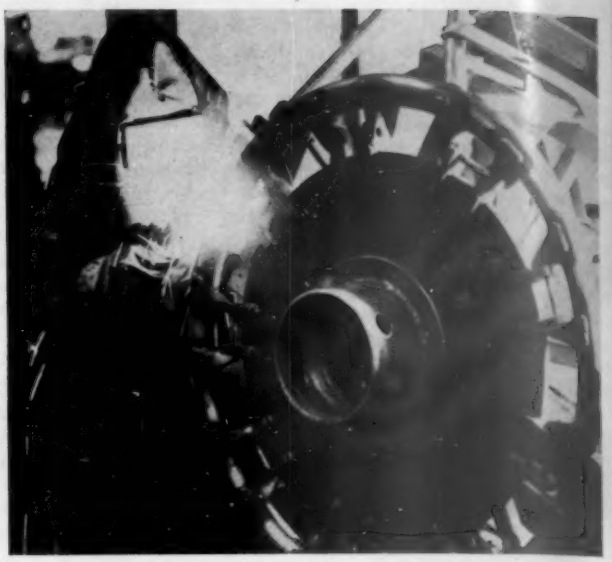


In structural steel fabrication, engineers are gradually becoming more welding conscious. Here an arc welder is making a beam-to-column connection on a new office building in Kentucky. Photo (Frank Blazie.)



Arc welding a special frame of tubular members used by Boeing Aircraft Corp., Seattle, Wash., for picking up fuselages with an overhead crane. Photo (Lincoln Electric Co.)

Classified Section

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